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PASSING PIONEERS.

We lay with deep regret this week our tribute of love and esteem on the grave of James D. Reid, the pioneer and veteran telegrapher, the friend of Morse, the historian of the early days of his art, and the benefactor of every member of the craft. To have founded the Telegraphers' Mutual Benefit Association was honor enough for him, but interesting and pleasant associations must ever cluster around his name in the memory of those who knew him in relation to telegraphy itself. To hear him tell how in the dim past they smeared the wires with wax to get better insulation, and thus demoralized the bees throughout the entire region; or to have reminiscences of the days when Andy Carnegie was his sturdy messenger boy in Pittsburg—these and countless other anecdotes of the kind took one back more vividly than anything else could do to the exciting period when the telegraph had to struggle before it became the great agency for communication of modern times, affecting every department of life and intercourse. Old Scotland has sent us many a good and true man, but none of nobler quality than he who became the first American superintendent of telegraphs, and has now passed on to his well-earned rest, ripe in years and in the affection of the land of his adoption.

TELEPHONE ENGINEERING.

The New York Electrical Society has had some remarkably good meetings this winter, and one of the most instructive was that at which Mr. Kempster B. Miller discussed the latest features of telephone engineering. The lecture having been prepared for publication has been given out to the press, and some of its most useful portions appear in our pages this week. The society has, we are glad to learn, arranged for its appearance in pamphlet form. This lecture comes from an "independent," and we can only wish that the Bell interests would relax in their policy of silence and again contribute to the recorded literature of the art. We cannot but believe that they, too, would be gainers by adopting a more liberal attitude in this respect.

PAN-AMERICAN AND TRADE.

This month at the Pan-American Exposition at Buffalo the United States welcomes the world, and especially the sister communities to the South, to inspect her resources as exemplified in manufacturing and other products. She has also brought to Buffalo a remarkably fine collection of the products of Central and South American countries, so that the European who comes over this year has a particularly good opportunity to judge of the conditions of commerce, manufacture, mining and agriculture in the Western Hemisphere. The Buffalo Exposition, as our article this week on only one aspect of it indicates, is well worth a visit, and we are glad to know that it is the goal of a good many engineers and manufacturers from all parts of the world. They may rest assured of hearty hospitality. This country is bent upon doing all the international trade it can get, but there is a keen realization, ever growing and widening in American minds, that such trade must be based upon the cultivation of friendly relations, on reciprocity in its finest manifestations, and then upon sheer merit in the goods offered to foreign consumers.

Buffalo and Niagara are the meeting places this year of various electrical bodies, beginning with the National Electric Light Association this month, and followed up by the American Institute of Electrical Engineers, the National Independent Telephone Association, the International Association of Municipal Electricians, etc. We are glad to know that the Institute is already making extensive

plans to repay in kind the warm and hearty hospitality extended to its members last year upon the occasion of its first trip to England and the Continent. No matter how many may come, it is preparing to give its friends from abroad not only an interesting time at Niagara and Buffalo, but an unequaled opportunity to study our great electrical plants and electrical manufacturing establishments.

Turning at this juncture to the more prosaic questions of trade, it is significant that with the opening of the Pan-American comes the showing that the United States has unquestionably attained leadership as an exporting nation. It could not long remain otherwise with the growth of the country, the influx of foreign population, the extension of agriculture and, above all, the growth of industries. Indeed, proportionately to population, some of the European countries still do better than the United States. But the fact remains that according to the Treasury Monthly Summary of Commerce and Finance, the average monthly exportations for the nine months ending with March, 1901, were $124,497,853, while those of the United Kingdom, our closest competitor, were $117,816,246 per month during the same period. Those of Germany, the next largest exporter, $87,551,000 per month during the 12 months ending with December, 1900; France, $56,467,000; Russia, $29,550,000 per month; British India, $26,747,000 per month; Austria-Hungary, $25,753,255 per month; Belgium, $23,568,000 per month, and Italy, $20,518,000 per month.

The total domestic exports of the United States in the nine months ending with March are $1,120,480,673, while the exportation of British and Irish produce in the same period is $1,060,346,214, showing the exports of the United States to be $60,000,000 greater than those of the United Kingdom, her greatest rival, during the term under consideration. We are glad, however, to note many signs of encouragement and activity in British trade again, and to see the signs brighter in Germany. It is, after all, only in common prosperity that the great nations of the world can go forward in the arts of peace and civilization, and the gain of one is the good of all.

Electricity in Mountain Mines.

A paper of this title by Professor F. W. Brady was read at the last meeting of the A. I. E. E., and is noticed elsewhere in these columns. It describes some of the difficulties the engineer has often to face in the installation of a plant in mountainous regions. It often happens that the difficulties of transportation are greater than all the other difficulties connected with the mining installation of electrical apparatus. Moreover, machinery must be of the strongest, which will stand manipulation in mines and on board ship. Not only is the character of service apt to be most severe in such cases, but the facility of effecting repairs is also the least.

A peculiarity of Colorado mountain lines seems to be in their danger from lightning, electrical discharges sometimes occurring at high altitudes without the appearance of clouds in the neighborhood. In such cases "a thunderbolt from a clear sky" is no mere figure of speech. The difficulty with lightning and lightning discharges also tends to increase with the pressure employed in transmission. It is also difficult at times to obtain adequate ground connection for lightning arresters in mountain regions, and a mine often offers a special temptation to lightning, by reason of the better ground connection obtained in it than outside it. A barbed iron wire carried above the working conductors is sometimes used, and has often proved of benefit, although occasionally troubles have occurred from accidental grounds and contacts between a working conductor and the grounded barbed wire. The generating station is usually well protected, since being almost always driven by water power, a good ground can readily be established. The receiving end is where the difficulty usually occurs.

Efficiency of Steam-Pumping.

Some interesting tests, recently made upon a vertical triple-expansion 800-hp pumping engine having a capacity of more than a million gallons per hour, make it appear that in large steam plants under steady load, for which pumping gives almost an ideal presentation, the coal per ihp hour is only a little over 1 lb. (1.02), and that in such plants we may shortly expect to find the consumption reduced to 1 lb. avoirdupois per ihp hour, and under workaday conditions as distinguished from test conditions.

In the case recorded the boiler efficiency was over 80 per cent, and including the economizer, 85.9 per cent, while the thermal efficiency of the engine was 21.63 per cent, with a boiler pressure of 187.4 lbs. and 12½ lbs. water evaporated per pound of coal from and at 212 degs. F. Good as this result appears to be, and excellent by comparison with records of 30 years ago, it is still sad to see that only about 20 per cent of the thermo-chemical value of the coal burned was realized in mechanical energy, and that about 80 per cent was not utilized, most of it through the action of the inexorable second law of thermodynamics, being unavailable for transformation into mechanical energy through the agency of the heat engine in any of its forms. The above record is very close to the maximum efficiency of the steam engine, and while the gas engine promises somewhat greater economy, any significant improvement in utilizing the potential energy of coal must await a process of transformation in which heat will play no part, or a comparatively minor one. It is interesting to note that the economical production of light is at present limited in the same manner as the economical production of mechanical energy—in both cases by the intervention of heat between the original source of energy and the final transformation.

The Transformer for Measuring Large Direct Currents.

An abstract of Professor Ryan's paper appears in this week's issue. It is theoretically interesting, as pointing out the flexibility of the alternating-current transformer, in that it may be used for the measurement of direct currents, and it is practically useful as supplying a long-felt want. The potentiometer method of calibrating direct-current ammeters, as used in laboratories, can scarcely be improved upon, no matter how powerful the currents may be. In a central station, however, the inconvenience and trouble of interrupting large conductors in order to insert into their circuit the necessary measuring apparatus, when the ammeters have to be tested, make welcome any plan by which a reasonable degree of accuracy can be secured by indirect means.

The principle of the method depends upon the fact that magnetized iron responds less readily to cyclical magnetization than the same iron initially unmagnetized. In other words, after iron has been magnetized in one direction or the other, its permeability to cyclical magnetization is less than when in the normal unmagnetized condition. This fact is usually a disadvantage which has to be faced and supported in connection with dynamo-electric machinery, since the approach of iron to the magnetically saturated conditon requires a considerable increase in the excitation to produce an increase in the magnetic flux. The failing is in this case, however, turned to advantage. An alternating-current transformer of the step-

up type, designed so as to have the minimum magnetic leakage, is constructed with one turn of heavy conductor to carry the current to be measured, and with a number of turns of correspondingly smaller cross-section in the balancing coil, corresponding to the secondary coil as ordinarily employed. A comparatively feeble, and easily measured current is then passed through the latter coil, until its magnetomotive force is just equal and opposite to that of the large current flowing through the single turn. As soon as this balance is obtained, there will be no magnetic flux in the magnetic core of the transformer, and this condition is determined by using an alternated or cyclically reversed current in a testing coil on the same core, and observing when the e. m. f. so induced is a maximum in an associated secondary coil. As soon as the maximum is reached, the unknown strong direct current is greater than the measured weaker direct current, in the ratio of the number of turns in the multiple-wound exciting coil.

The advantage of the method lies in the convenience of its practical application at the switchboard. The testing transformer can be slipped over the blade or blades of a large switch at a moment's notice, and the measurement can then be made under practical conditions, assuming that the load is fairly steady, and that the current to be measured does not therefore vary rapidly. The method, then, essentially consists in causing the powerful unknown current to produce a magnetic flux in iron which can be neutralized by the m. m. f. of a measured current. Consequently, it is the magnetic field of a current which is virtually measured and not the drop of pressure produced in the known resistance by that current. The latter method, which is the ordinary plan, requires the introduction of a large and cumbersome piece of apparatus into the main circuit, at a considerable expenditure of time, and often with much inconvenience.

METHODS OF STREET LIGHTING.

Ordinarily one does not expect from committees of city governments reports of real technical value, but the report of investigations into methods of street lighting, which we noticed briefly in the last issue, is on a pedestal by itself. Messrs. Mullen, Wiebling, Schweninger, O'Brien and McDonough, of Cincinnati, deserve to go down into history as a committee that could round up the lighting facilities of a dozen cities unscathed and reach definite and valuable conclusions. We wish that they represented some other cities that we could name. The virtual subject of their investigation was the relative merits of arc lights and Welsbach gas burners for street lighting, and incidentally the comparative values of open arcs and enclosed arcs, both direct current and alternating,. Incidentally, there were disclosed some very instructive data as to relative costs, and relative continuity of service.

It is now some years since the Welsbach light has been extensively exploited for street lighting. Of its theoretical economy as an illuminant much that is favorable can be truly said. It is a very great improvement over the open gas flame in steadiness and efficiency, distributes its light well and gives initially a high candle-power. Used with gasoline gas, generated on the spot, it is a very convenient method of getting a strong light in districts where gas mains are not yet laid nor electric wires strung. It has been pushed into use in many cities large and small on account of its alleged virtues, and for other and less sanctified reasons, and is employed on a scale extensive enough to permit a fair judgment of its qualities based upon experience. And, as in many other instances, theoretical promises have not been fulfilled by the performance of things as they are. In the first place, the color of the Welsbach light and all its kindred is highly objectionable. At best, it is a greenish-white, of unhealthy appearance, and on the average a ghastly hue only fit for the illumination of a morgue or other district where the inhabitants do not worry about appearances. It is the color that condemns the quality of the light, and although new varieties of mantle have been reputed to be free from such objection it has never been our fortune to see them on the streets or anywhere else. In domestic lighting colored shades can mitigate the unpleasant hue, but we are not aware that this remedy has ever been applied to Welsbach street lights. Aside from this matter of color, the mantles—certainly when used out of doors—grow very rapidly dim, so that it is exceedingly hard to find a street that is really well lighted by these burners. Nothing short of a constant scourge of inspection and fines seems to be able to keep them going at anywhere near their rated brilliancy. Moreover, it transpires from the Cincinnati investigation that they are not really cheap. Their average contract price in the cities investigated wherein both arcs and Welsbach are used was $29.48, the cost of arcs in the same cities being $97.42. Now, one modern arc light consuming, say, 480 watts, is materially better than three Welsbachs, basing the comparison on the minimum illumination alone, while if any value be assigned to the average illumination the light of the arc is immensely superior. An agitation for lighting contracts, based on a measured minimum of illumination, is an almost infallible sign that an exploiter of Welsbach lights has quietly visited town.

As to arc lights, the Cincinnati committee found almost everywhere a strong preference for the enclosed arc, based on better distribution of light, greatly increased steadiness and greatly diminished number of lamps reported out. Of course, the first mentioned advantage is notorious. There is really no comparison between the open and enclosed arcs in this respect, since with the latter not only is the light thrown out at a much better angle, but the whole inner globe serves as a radiant surface so that the lamp supports do not cast troublesome shadows, and all the shadows are less sharp and dense. The increased steadiness is also a well known property, but it is not so generally understood that the open arcs are the more likely to be out. But such is the fact, compared even with alternating arcs which are popularly supposed to have more delicate mechanism than continuous-current lamps. The old open arcs were wonderfully reliable mechanisms, but the need of frequent trimming gave more opportunities for disarranging them, and improper trimming was responsible for many failures. As to the relative value of the different classes of arcs as illuminants, there seems to be a general agreement that the 480-watt direct-current enclosed arc is fully equal and, on the whole, superior to the so-called 2000-cp open arc. And what is more striking, there seems to be an inclination to regard the 6.6-ampere series alternating arc, properly hung, as the practical equal of either of the others. From a photometric standpoint this statement would seem exaggerated, but illumination cannot be estimated entirely from a photometric basis, since there is no doubt whatever that lowering the intrinsic brilliancy of a light while retaining the same candle-power will of itself make the illumination more satisfactory, and the strong horizontal rays from the alternating arc are of great service. Ordinarily, many would prefer an alternating arc taking about 7.5 amperes if replacing 480-watt direct-current arcs, lamp for lamp. We regret that the investigation did not extend to the enclosed arcs of moderate candle-power, taking 5 amperes or thereabouts. These are coming into use as substitutes for the nominal 1200-cp open arcs, but their real illuminative value has not, to our knowledge, yet been thoroughly investigated. It assuredly is worth it, for it appears that rather small arcs are decidedly useful in dealing with certain classes of street lighting.

Death of James D. Reid.

Every one who has enjoyed the acquaintance of Mr. J. D. Reid will regret to hear the news of the death of that veteran telegrapher this week. He was 82 years old, but had only lately succumbed to the burdens of his age, rallying at first from a surgical operation it was necessary for him to undergo. It is not so many weeks since he was downtown and a visitor at several offices, including this, when he had a bright smile and a cheery joke. Nor is it so many months since he played his last game of golf.

Mr. Reid was born in Edinburgh, Scotland, on March 22, 1819. In 1834 he moved with his family to Toronto, Canada. He took a position as a junior clerk in the Toronto branch of the Commercial Bank of Kingston. He came to the United States in 1837, and at the age of 18 years became a clerk in the Rochester post office under Henry O'Reilly, who, in 1845, obtained a contract for the construction of a telegraph line from Amos Kendall, Postmaster-General, then Professor Morse's agent and attorney.

In 1845 Mr. Reid was made an assistant to Mr. O'Reilly in the construction of the work, and was assigned to the building of the line from Lancaster to Harrisburg, Pa. His next appointment of importance was that of superintendent of the Magnetic Telegraph Company, a line from New York to Washington, and the superintendency, too, of the Atlantic & Ohio Telegraph Company, which ran a line to Pittsburg from Philadelphia. So far as can be definitely setled, he was the first regular superintendent anywhere of a commercial telegraph line.

In 1856, when the Western Union began to absorb the individual lines, Mr. Reid was made superintendent of the New York, Albany & Buffalo Telegraph Company, which was soon absorbed by the Western Union with the rest. Several other companies with which he was identified were also taken in subsequently. During his telegraphic career he was wounded in the head by some unknown assailant while at work, and he felt the effects of the blow all through his life.

Mr. Reid had a marked taste for literature and founded and edited the *National Telegraph Review*, a quarterly of the early fifties. In 1877 he published his first edition of the Telegraph in America. He was also editor of the *Journal of the Telegraph*, was intimately acquainted with Professor Morse, Cyrus W. Field, Hiram Sibley, William Orton, Peter Cooper, Marshall O. Roberts, Wilson G. Hunt, William Cullen Bryant, Henry Ward Beecher and William E. Gladstone; and his gossipy history of the telegraph includes many anecdotes of the early telegraph leaders and their work, as well as the record of telegraphic commercial development.

One of the things of which Mr. Reid was most deservedly proud in his career, next to the friendship of men like Morse, was his organization of the Telegraphers' Mutual Benefit Association, of which he was the first president. He was a warm-hearted man, and one of his early deeds of kindness to Andrew Carnegie, when that millionaire was his messenger boy in Pittsburg, was never forgotten by its recipient, and was more than once generously repaid. Mr. Reid was appointed also United States Consul to Dunfermline, Scotland, through Mr. Carnegie's influence with President Harrison, and spent some happy years on his native soil, being confirmed in the appointment by President Cleveland. Mr. Reid also enjoyed the friendship of Mr. Rockefeller, who, making some judicious investments for him in Standard Oil and acting as his banker, put him into very comfortable circumstances during the closing years of his life.

Mr. Reid is understood to have left a widow and a married daughter, both of whom are living in Great Britain. The funeral services were conducted on Tuesday, and the interment takes place this week at Rochester, N. Y. The funeral exercises were attended by many of the amiable veteran's friends, who exchanged many stories and reminiscences of the early telegraphic days. Mr. Reid has himself, however, put forever on record in the pages of his "Telegraph in America" the thrilling and amusing episodes which attended the introduction of the new means of conveying intelligence, then so crude in its appliances and its technique. Thus passes away an interesting personality, a lovable character and the last link that united the pioneer work at the very outset of electrical applications with the great developments of the new century. Like many another Anglo-American, Mr. Reid gloried in the generous country of his adoption, but deep down in his heart lingered a strong pride in his Scottish blood, and loyalty to the hills and heather, about which he could never speak without tears in his eyes and voice.

Mr. Scott on Induction Motors.

The New York Electrical Society held another extremely successful meeting on April 25 at 8 p. m. at Havemeyer Hall, Columbia University, when Mr. Charles F. Scott, chief electrical engineer of the Westinghouse Electric & Manufacturing Company, lectured on the subject of "Induction Motors." In spite of the rainstorm which was the climax of two weeks of steady wet weather, no fewer than 250 members climbed the heights to Columbia and were rewarded by hearing a most instructive and valuable lecture on the topic in question. Mr. Scott explained the characteristics of different types of alternating-current motors and paid particular attention to the induction motor. These in turn were considered in their various forms and the adaptation of the various types to different classes of service was brought out in detail. The difference between motors of this type and direct-current motors was also discussed in an illuminative manner, and a large variety of performance curves as to speed, load, etc., were shown by means of wall diagrams. The lecture was supplemented by a large number of lantern slides dealing with the induction motor in its industrial application. Additional interest was given to the lecture by the demonstration of various phenomena by means of motors in actual operation, beginning with the phenomena of the rotating magnetic field as elucidated by Mr. Nikola Tesla; and following the subject through its various stages of development, Mr. Scott proceeded to show in operation types of the Westinghouse induction motor and made also a series of brake tests.

As was the case with the Steinmetz lecture, it was immediately decided by the members that the address should be put into type for general circulation, and Mr. Scott has kindly consented to do this, so that the lecture may be added to the society's publications for the season.

The following members were elected at the New York meeting: W. E. Gavit, Tucker Electrical Construction Company; Robert B. Corbett; J. C. Lynch, New York Telephone Company; Ralph Straschnow, William H. Eckert, Willard M. Miner, W. Stanley Eckert and H. P. Marshall, all of the Knickerbocker Telephone & Telegraph Company; Willard B. Kendall; C. E. Fairbanks, New York & New Jersey Telephone Company, Paterson, N. J.; Dr. Ralph Julian Sachers; Edwin L. Ross; J. C. Weart, Western Electric Company; Edgar H. Stevens, C. E. Brown.

We are requested by Secretary Guy to state that Mr. Steinmetz's lecture on alternating currents has been printed and can now be had from him at 120 Liberty Street, for 25 cents per copy. The lecture by Mr. K. B. Miller on "Modern Telephone Engineering," profusely illustrated, is now in press, and will be issued at the same price. As stated above, Mr. Scott's lecture is now to be printed also.

Programme of the National Electric Light Association

Mr. George F. Porter, secretary of the National Electric Light Association has issued the following programme for the convention of May 21-23. Papers will be read as follows: "Arc Lighting at the Beginning of the Twentieth Century," by H. W. Hillman; "The Practical Side of the Incandescent Lamp," by F. W. Willcox; "The Foresee (4-C) System of Charging," by Louis R. Wallis; "A Station Load Diagram," by C. R. Van Trump; "Distribution of Current at High Potential in New York City," by Calvin W. Rice.

Reports will be presented by the committees on Grounded Circuits, Rules for Electrical Construction and Operation, Standard Candle-Power of Incandescent Lamps, Photometric Values of Arc Lamps, Analysis of Flue Gases, The Legislation Regarding Theft of Current, Amendments to By-Laws, Amendments to Freight Classification of Electrical Apparatus, Legislative Policy, Uniform Accounting.

The International Hotel has been entirely reserved for those attending the meeting. Rates, American plan, $5 per day, with bath; $4 per day without bath. The respective Passenger Associations covering the territory east of the Mississippi River have granted a rate of a fare and one-third, on the certificate plan, for delegates and friends attending this convention, from all points in their territory to Niagara Falls and return.

The dedicatory ceremonies of the Pan-American Exposition at Buffalo, a half hour from Niagara Falls, will be held on Monday, May 20, the day before the opening of the convention, thus enabling members and delegates to attend within the time limit of their tickets.

An English Combined Central Station and Destructor Plant.

ONE of the peculiarities of London government is the reservation to numerous communities which form the geographical city, of power to control the supply of electricity within their bounds. One effect of this is naturally to prevent the carrying out of a comprehensive scheme of generation and distribution of electric current, as is done in the case of American cities. Still another and perhaps more serious effect, flows from the tendency of the smaller governing bodies to take a narrow view in considering the subject of public utility establishments, which tendency in England is aggravated by a fear on the part of such bodies of allowing private enterprise to enter into this field. An example of the manner in which electrical industry is hampered by this condition is afforded in the history of the newly established central station plant of the borough of Fulham, London.

For many years the question of electricity supply was discussed by the Fulham vestry and differences of opinion on the subject developed which from time to time gave rise to heated debates and considerable friction. Finally, in 1895, a committee was appointed to consider the desirability of obtaining authority to erect an electric lighting plant in connection with a refuse destructor. In the fall of that year the services of an electrical engineer were secured, and two years later authority to erect a plant was obtained, and in 1898 the drawing up of the plans was commenced. Disputes over the awarding of the contracts delayed the establishment of the plant, which only commenced operation last month.

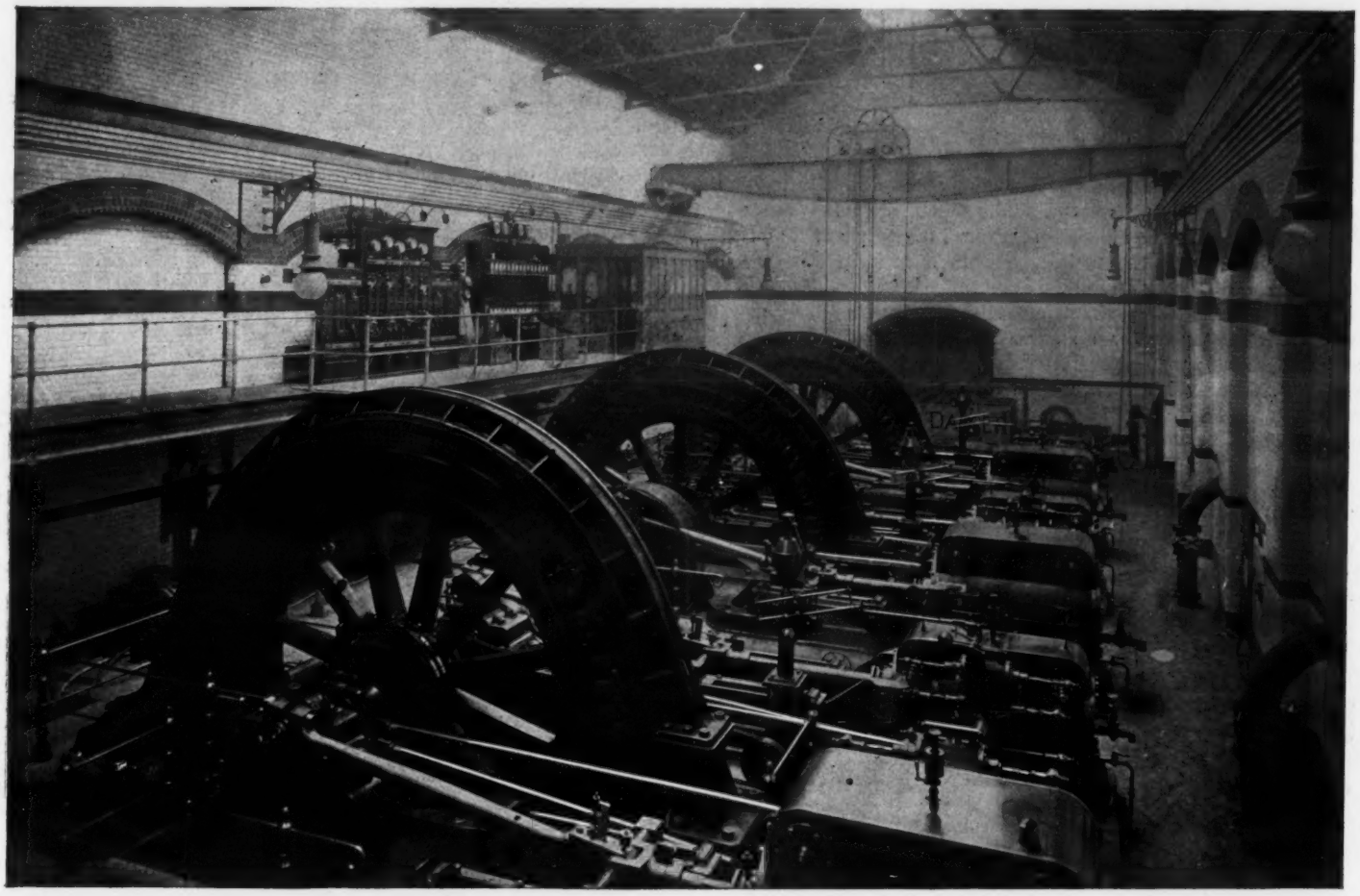


FIG. 1.—GENERAL VIEW OF ENGINE ROOM, FULHAM, LONDON.

The plant as erected has a capacity for 30,000 8-cp lamps, and cost, in round figures, about $540,000. Of this amount $115,000 was taken for buildings, $80,000 for the refuse destructor and boiler plant, and $230,000 for the electrical generating plant.

The generating room of the Fulham plant is a handsome apartment 110 ft. long, 42 ft. wide, and 30 ft. in height to the springing of the roof. The walls are entirely faced with white glazed bricks, relieved by bands and string courses of salt glazed bricks. The floor is paved with mosaic work, with hand-laid borders. A special feature of the room is the absence of all pipe work, this being arranged under the floor level. A gallery runs round two sides of the room, and carries the main switchboards and a switchboard attendant's office. Space is left at one end of the room for an extension engine and dynamo. Two entrances to the destructor house are provided from the engine room, one from the gallery and one from the floor, and these will be carefully protected by double doors and glazed screens, with the object of keeping out dust.

The alternators are three in number, each set consisting of a two-phase generator of the flywheel type coupled directly to a horizontal compound condensing engine. The engines are of the Musgrave slow-speed Corliss type, and each is designed for 450 b. h. p. when supplied with steam at a pressure of 130 lbs. per square inch at the engine stop valve and a vacuum of 24 inches of mercury in the exhaust pipe, the governor being specified to control the speed within 3 per cent from no load to full load, and to be adjustable while running to vary the speed 5 per cent about the mean speed.

The three two-phase generators (Fig. 2) are of the well-known Oerlikon design, but were constructed by the General Electric Company at its Manchester works. Each generator is capable of giving a normal output of 300 kilowatts at all e. m. f.'s from 2800 to 3000 volts at the terminals of the machines. The machines will also run continuously for two hours overloaded at 330 kilowatts. The speed, as already stated, is 93.7 r. p. m. and the frequency 50 p. p. s.

The energy stored in the flywheel when running at its normal speed is 1,800,000 ft.-lbs. The field-magnet poles, with their windings, are fixed on the periphery of the flywheel. The poles are laminated, rivetted together, and fixed to the flywheel rim by means of steel wedges, the latter being securely fastened to the flywheel by strong bolts passing through its rim. There are 64 laminated poles on each flywheel, wound with round copper wire, the exciting current being brought to them through two slip rings. The diameter over the poles is about 14 ft. The necessary current for exciting the field coils is obtained from the continuous-current dynamos driven by high-speed engines.

On the inner circumference of the stationary armature are spaced 256 slots, which carry the copper windings. These windings are arranged to form two circuits, one for each phase. The windings of the one circuit have straight ends, while those for the other circuit

have bent ends, as is the usual practice. The insulation between the coils and the iron frame is efficiently effected by mica tubes, the coils being fastened securely in the slots by means of strong fibre wedges. In Fig. 1, which gives a general view of the engine room, the upper sections only of the shields covering the end of the windings are in place. The two series of windings are quite independent, and their

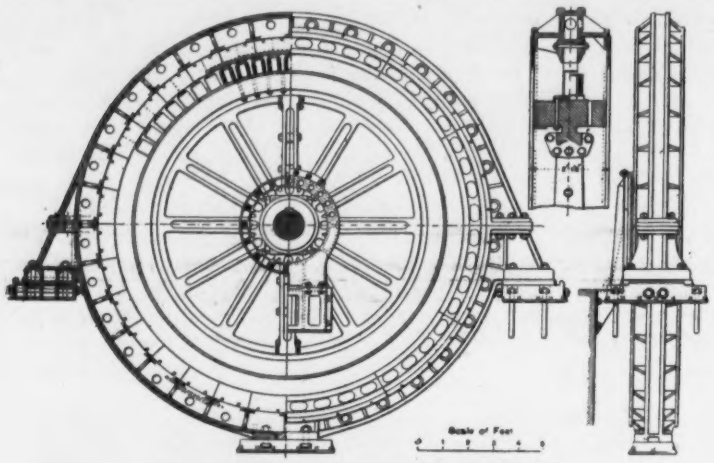


FIG. 2.—300-KW TWO-PHASE GENERATOR.

four ends are brought out to terminals from which the current is carried to the switchboard.

There are three direct-current dynamos, which were also made by the General Electric Company, for exciting and light and power supply in and about the works. Each is capable of giving an output of 600 amperes at 100 to 110 volts at a speed of 460 r. p. m., and each is directly coupled (on one bedplate) to a Musgrave high-speed enclosed type compound engine.

The dynamos, either of which is large enough to supply the exciting current necessary for all three alternators, are shunt-wound, having four poles with cast-steel yokes, while the armatures are of the slotted type with form-wound coils placed in the slots. The commutator is built up of hard-drawn copper, and is fitted with carbon brushes, and the machine is built to conform with the usual specification as to temperature and fixed position of brushes.

There are two arc-lighting circuits, shown 0 and 6 on the map, with 43 or 44 lights on each circuit. These are supplied by three Ferranti rectifiers (Fig. 4) of the standard 50-light pattern, which are placed in one corner of the engine room under the stairway. There is space for a fourth, although at present one of the three is a stand-by. The switchboard in connection with these is of the usual type constructed by Messrs. Ferranti for this purpose, and it is fixed on the wall beside the rectifiers. It is arranged for three circuits, any one of which can be fed from any one of the rectifiers.

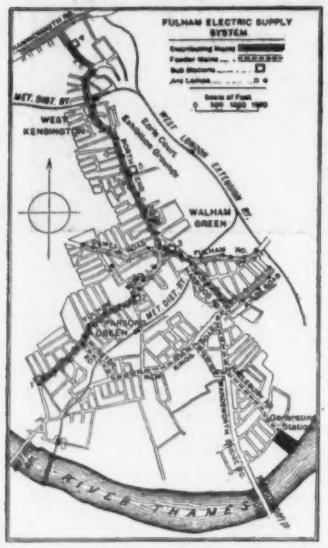


FIG. 3.—MAP OF POSITION OF MAINS.

The three alternator engines are fitted with Korting ejector condensers placed partly above the engine room floor level and partly in the pipe trench. A branch is run from each condenser to the main exhaust pipe, in which is fixed a Blake and Knowles automatic exhaust valve to enable the steam to reach the atmosphere in case of any failure of the condensing plant. Each condenser is required to give a vacuum of 24 inches of mercury when dealing with 10,000 lbs. of steam per hour. The condensers are supplied with water from a large tank, placed on the roof of the pump room, and kept filled by three motor-driven centrifugal pumps of 18 b. h. p. each, running at 1200 r. p. m., the motors being of the General Electric Company's make. These pumps are placed in the pump room, and are each capable of delivering 33,000 gallons of water per hour with a total lift of 48 ft. at low tide.

The high-pressure switchboard for controlling the 3000-volt two-phase currents is of Messrs. Ferranti's standard pattern, and is placed in the gallery 10 ft. above the engine room, as seen in one of the illustrations. It consists of 16 panels, providing for the 6 circuits of the three two-phase alternators, two rectifier circuits, and the testing circuit, and there is one spare panel. The controlling gear for the alternators is fixed below board on the regulating table, the alternators are regulated by open type rheostats in series with the field. In connection with the high-pressure board, a Ferranti plug testing box has been fitted, from which leads are run to the instrument room. Plugs can be inserted in the box and connected to any panel on the high-pressure board for making insulation tests. There are three Ferranti wattmeter panels, one for each alternator. Two wattmeters are fixed on each, with cut-outs, transformers and fuses, there being one recording wattmeter in each phase. Kelvin instruments are employed on the switchboards.

One terminal of each phase is permanently earthed to the earth bar of the switchboard in the usual manner, and, of course, the switch and fuse connections are all on one pole. The synchronizing contact is made in connection with one phase only of each alternator, the handles of the two switches of each alternator being joined by a cross-piece.

All the principal connections between the machines and the switchboards run beneath the floor, and are of rubber insulated cable which, in the case of high-pressure mains, is also lead-covered.

The two-phase high-pressure currents are led by means of pairs of concentric lead-covered cables to five stations. Here they are transformed down to 200 volts each phase in stationary transformers and distributed at that pressure to the consumers. In the low-pressure cables, the phases are also kept apart, and one employed on each side of the street. If a motor is required, a service line is run across the street and both phases are brought in. The high-pressure feeders, running in pairs of concentric cables whose outers are earthed at the station switchboard, may be traced out on the map of Fig. 3 as follows: A 7/14 feeder runs to Munster road, where it divides, 7/16 cables being "swallow-tailed" off at either side to the sub-stations 1 and 2. To No. 3 sub-station there is a 7/15 feeder, consisting,

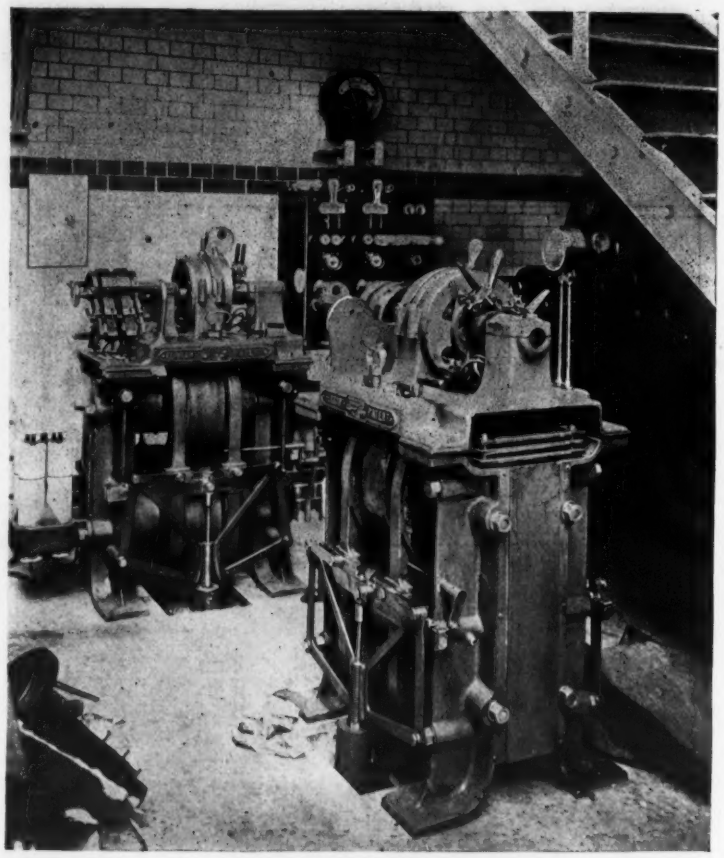


FIG. 4.—FERRANTI RECTIFIER.

as in all cases, of a pair of concentric cables, and to No. 4 a 7/14 feeder. The latter is tapped to supply No. 5 sub-station. To avoid confusion in the map, owing to the small scale, the course of the feeders is merely shown by one dotted line whether one or more feeder, runs down the street; but the above explanation makes the arrangement quite clear. Streets in which there are distributors are

shaded, and it is seen that there are no distributors in close proximity to the works. The arc-lighting circuits, which are independent, have already been referred to.

All the cables are lead-covered and drawn into Doulton ducts under the footpaths and into cast-iron pipes where under roadways. At road crossings, however, wrought-iron pipes embedded in concrete have been used, special reducing pieces of Doulton ware being employed for gradually changing the shape of the way from the

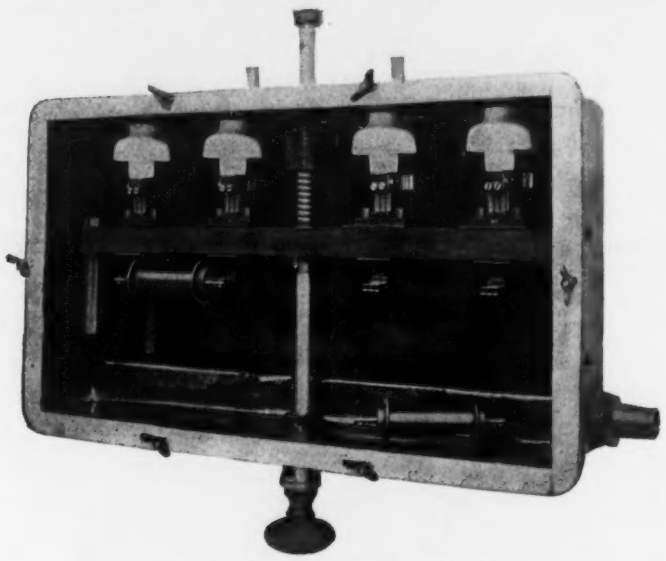


FIG. 5.—HIGH-PRESSURE SWITCH.

square to the round form. Service and network boxes are made use of, the type with brass sleeves for plumbing to the lead of the cable having been chosen. The boxes are filled up with compound. Spare ducts have been provided liberally for future extensions.

There are at present five sub-stations, each of which contains two 50-kw transformers, one for each phase. The switching arrangements, as well as the transformers, are placed in watertight cases; all iron work is earthed, and a Cardew earthing device fitted to each transformer. Due provision has been made for ventilating the sub-stations, which are lighted with incandescent lamps supplied off the centric feeder enters through the lower right-hand gland, the outer conductor being connected to the upper right-hand switch contact and the inner to the corresponding contact on the extreme left. The connections to the transformers enter through the smaller glands on the top. On turning the handle fitted to a spindle coming through the bottom of the box the cross-bar making the two contacts draws away sharply. The brake of the switch itself appears small, but is said to be effective. The cross-bar carries the fuses, which are contained in ebonite reels fitting into spring contacts on the bar.

The low-pressure box has glazed doors, the fittings consisting of a pair of bus-bars mounted on a marble base. The cables enter through glands, and the connections are made through convenient switch-fuses with substantial stoneware handles.

The public lighting is by 86 open-arc lamps, carried on posts of ornamental design, bearing the borough arms, and run in two circuits of about half the number on each. The lamps are 12-ampere 32-hour double-carbon lamps, and are fixed about 25 ft. from the ground. Brackets are also provided on each post for two 32-cp incandescent lamps, which are automatically switched on when the arc lamps are switched off or fail.

Except in the offices, the cables in the station are carried in watertight "Simplex" steel conduits. There are six distribution boards, to which the current is transmitted from the works lighting board, placed under the switchboard gallery in the engine room. The inclined roadway and destructor house are lighted by eight 12-ampere arc lamps, four similar lamps being suspended from swiveling brackets, two on either side of the engine room. There is also a large number of incandescent lamps, and wall plugs have been provided at all points where hand lamps will be required for inspecting and cleaning purposes.

The charge for lighting purposes is 10 cents per kilowatt-hour, and for motive power 5 cents per kilowatt-hour during the hours of daylight. The meters employed are of three types, Hookham, Thomson and Aron. No meter rent will be charged. Our London contemporary, the *Electrician,* from which we borrow this description, says that it is satisfactory to note that the number of applications for energy already amount to an equivalent of some 10,000 8-cp lamps, including a number of elevator motors.

THE DESTRUCTOR PLANT.

Of perhaps the greatest interest to American readers is the refuse destructor plant portion of the installation. The destructor and

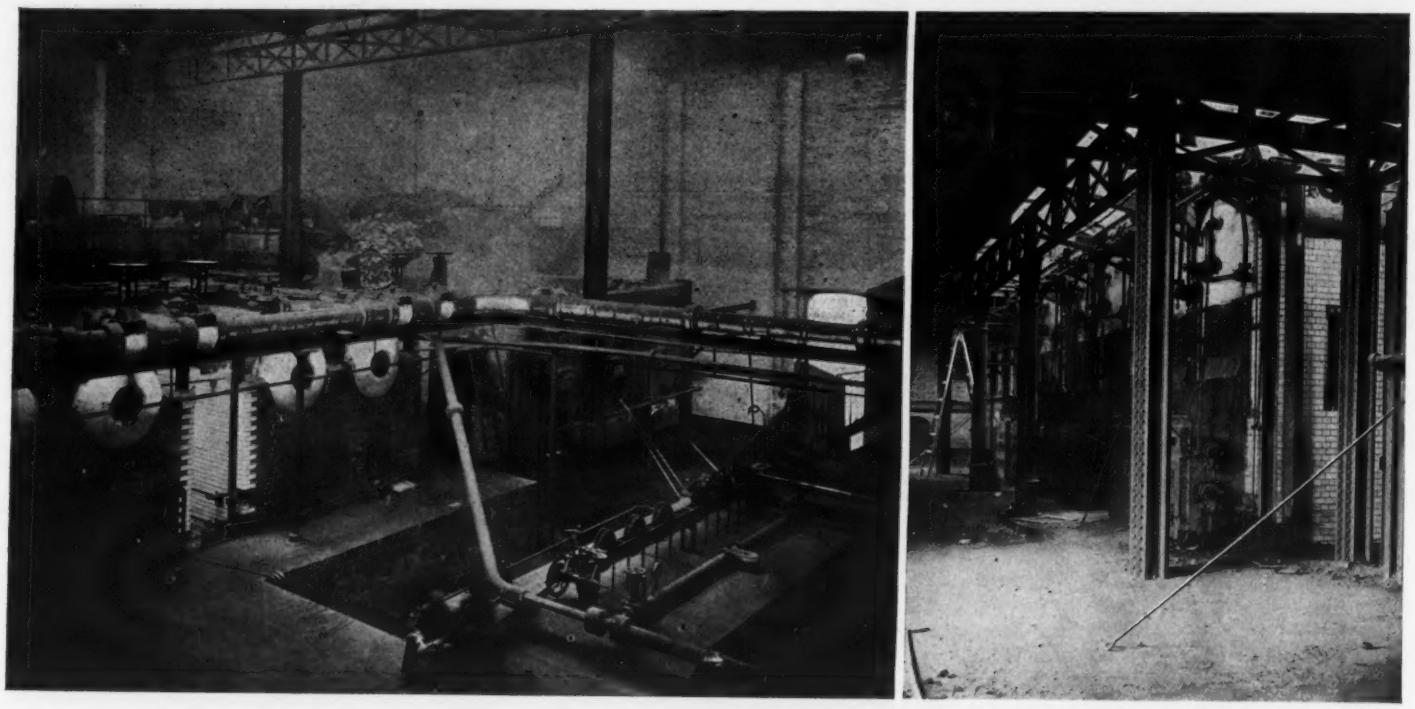


FIG. 6.—DESTRUCTOR PLANT.

low-pressure bars in the switch boxes. The chambers themselves are well designed and are sufficiently large for their pair of transformers. Being lined throughout with white glazed bricks, they present a clean and wholesome appearance.

One of the high-pressure switches is shown in Fig. 5. The box itself is of cast-iron lined with micanite. The high-pressure con-

boiler-house is a lofty building 35 ft. high to the springing of the roof, 137 ft. in length and 87 ft. wide. It contains 12 destructor cells with room for an additional four cells. The present cells are arranged in two groups of six each on either side of six Babcock & Wilcox boilers, and are capable of destroying efficiently 120 tons of refuse in 24 hours. Over the boiler-firing floor, and extending from

end to end of the building, is the tipping floor, to which the carts are brought for the purpose of discharging their loads onto the tops of the group of cells, where the refuse is fed into the furnaces. The tipping-floor is arranged to allow of the storage of a considerable quantity of refuse so that the working of the plant may be continued without interruption. Access to the tipping floor is obtained by means of an inclined roadway having a gradient of about 1 in 14, at the foot of which there is a weigh bridge and house where an account will be kept of the weight of refuse brought in.

The destructor furnaces have each a grate area of 30 square feet. The boilers have a heating surface of 1284 sq. feet, and are provided with mechanical stokers, which are electrically driven. An opening behind the bridge of each boiler leads the destructor gases in, the flue to this opening being provided with a suitable damper so that the boiler may be heated at will from the destructor or be fed with coal. Provision has also been made for firing the boilers by hand in the event of interruption in the working of the mechanical stokers, and forced draught induced by steam jets has been applied to each boiler. The boilers are constructed for a daily working pressure of 160 lbs. per square inch.

The refuse is fed into the destructor furnaces through charging openings on the tops of the blocks of cells, as mentioned above, the refuse itself closing the openings when the operation of charging is complete, and thus obviating the necessity for doors on the tops of the furnaces. Each furnace is provided with a sloping firebrick hearth on which the refuse rests before being drawn forward from below onto the grate bars. The grate bars have fine spaces between them and are made all in one length, so that there is no obstruction to the clinkering tools in traversing the length of the bars. The furnace crown is composed of special fire-resisting blocks, specially mixed and burned, capable of standing not only high temperatures, but rapid changes of temperature. At the sides of the furnaces, and extending about 8 inches above the grate bars, are cast-iron side boxes through which the whole of the air for combustion is passed. These boxes serve the double purpose of heating the air for combustion, and at the same time protecting the sides of the furnaces from the undermining action which takes place with brick sides, and is caused by the clinker adhering to the brick. Each of these side boxes is provided with a valve, controlled from the front of the furnaces, and openings for the delivery of the mixed air and steam, forming the blast, into the ashpit underneath the grate bars.

The air for the blast is drawn from above the charging decks of the furnaces, through large hoods, by means of powerful steam blasts, and thus ventilation of the upper part of the destructor house is assisted, and any smells arising from the refuse on the decks are partially drawn off and passed into the furnaces. The blasts force the air into longitudinal air passages extending under the furnaces and communicating by means of the valves above described with the side air boxes of the furnaces. There is a single outlet for the products of combustion from each furnace, placed in the crown of the arch at the front of the furnaces in such a manner as to draw off the escaping gases over the hottest part of the fire, thus cremating them before they leave the furnaces. The unburnt gases which have been given off by the refuse drying at the back of the furnace are thus subjected to a temperature of from 1800 to 2000 degs. F. before passing away to the flues.

The exhaust openings from the furnaces lead into flues, which in turn open into a main flue running the whole length of both blocks of cells and the battery of boilers between them, the flue being on ground level under the blocks of cells, but below ground level under the boilers. The furnaces are provided with massive steel buck stays and tie bolts, and with cast-iron cleaning and clinker doors, the latter being lined with firebrick. The clinker doors are of the balanced type, and are so arranged as to open the whole width of the furnaces at once. Branch flues, with dampers, are provided from the main flue to lead the gases into the furnaces of the boilers, and also by-pass flues, by means of which the hot gases can be led past the boilers to the chimney. The dampers in the hottest parts of these latter are swivel dampers of a special design, being kept cool by means of water circulation.

The destructor gases alone will be able to furnish sufficient steam to maintain the boiler pressure at 160 lbs. per square inch up to a certain point, but it is not anticipated that they will suffice at large loads. There will thus be considerable consumption of coal in the boiler furnaces and a coal-handling plant is being put down. The coal will be brought to the station by water, and will be raised from the lighters alongside the quay by a steam crane, and then dropped into a weighing machine, which automatically weighs, records and discharges the loads and adds up the successive quantities passing through the machine. After being discharged from the shoot of the weighing machine the coal is conveyed to the top of the bunker by an electrically-driven elevator, whence it is deposited in different parts of the bunker through shoots.

The clinker is drawn from the furnaces into iron skips carried on an overhead railway by which it is conveyed to the wharf alongside the river. Two Green economizers, each having a heating surface of 1920 square feet, are erected between the boilers, and there is a dust-catcher near the chimney. A by-pass is provided to carry the gases to the dust-catcher directly, when it is not desired to employ them for heating the boilers. The dust-catcher is a large circular brick chamber lined with firebrick, with a domed roof of the same materials. It is partly seen on the extreme right of our large illustration of the destructor house. The structure is strengthened by massive iron rings and buck-stays, and is so constructed as to cause the gases to swirl round rapidly within it in such a way as to throw off the dust which they carry along with them by centrifugal force. Cleaning doors are provided for the removal of the rust at any time

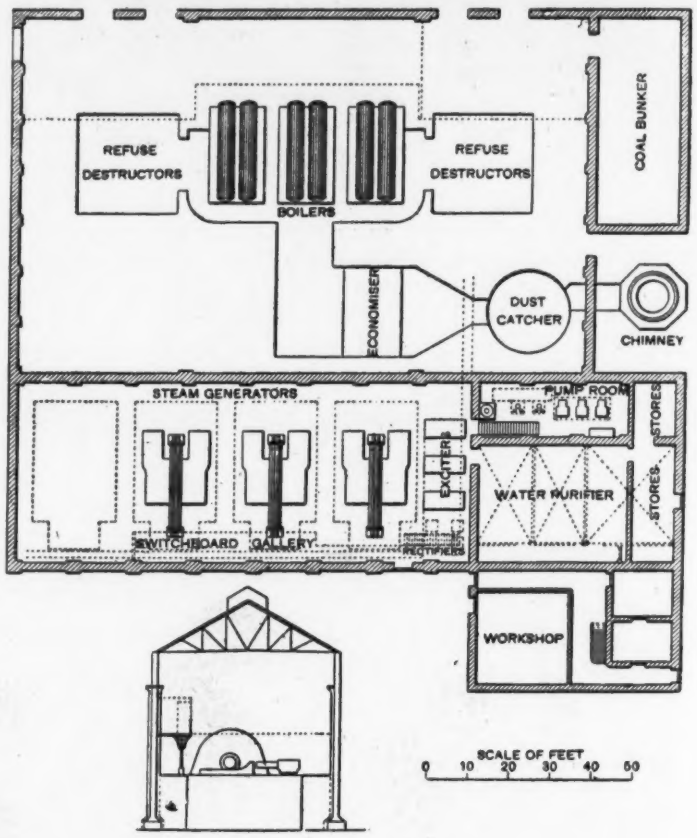


FIG. 7.—PLAN AND ELEVATION OF PLANT.

without stopping the furnaces. The chimney has a height of 100 ft., and an internal diameter of 8 ft. It is octagonal in form, and is lined throughout with firebrick.

It is estimated that the amount of refuse passed through the destructor per annum will be approximately 40,000 tons, and its calorific value is placed at one-twentieth that of good steam coal. The Borough Council therefore expects to save the cost of 2000 tons of coal per annum.

WATER-SOFTENING PLANT.

The supply of feed water is obtained from an artesian well sunk to a chalk level, and requires to be freed of carbonate of lime before use, for which purpose a water-softening plant is installed. The Atkins system is employed, whereby a certain quantity of caustic lime is added to the water, mixed with it, run into large tanks, where the chalk is precipitated, and finally filtered. The plant is capable of dealing with 8000 to 10,000 gallons of water per hour. The guarantee requires that any intelligent workman can operate the plant, and that water with 15 or less degrees of hardness must be softened so that the hardness is reduced to less than one-half grain of carbonate of lime per gallon if required. The plant, whose arrangement is illustrated in Fig. 7, consists of the following parts:

1. A lime slaking, straining and storing machine. 2. A cylinder in which lime water is formed. 3. A "mixer," being a shallow trough fitted with baffle plates. 4. A cistern in which the actual softening takes place. 5. A filter.

The method of working is as follows: The lime is delivered directly into a hopper, which forms part of the lime-slaking machine. The machine is set in motion, and in a few hours sufficient lime to last three weeks is automatically reduced to the form of cream of lime, and stored in a mill under the hopper. This mill is fitted with stirring arms and a self-cleaning strainer; about once a day the cream of lime is stirred, and a certain quantity pumped itno the lime water cylinder. A jet of water is admitted at the bottom of this cylinder, and passes out at the top as a saturated solution of lime water. It is then conducted to the mixer, where it is joined by the hard water. There are two specially constructed regulating valves by which any desired quantity of hard water and the correct proportion of lime water can be adjusted, and both supplies can be turned on or off without interfering with the other. While flowing through the mixer, the lime water and hard water mix automatically in a few seconds, and the water is delivered into the softening cistern, which is always full, and where water is always flowing through. It is during this period that the actual softening takes place, which may be described thus: Chalk is dissolved in water by carbonic acid gas, forming bicarbonate of lime. When quick-lime is added the gas releases the chalk, which, together with the lime, is precipitated. The chalk being no longer in solution, the water is now soft, but excessively turbid, owing to the deposit. This is removed by filtration.

The filter consists of a series of hollow disks covered with cotton filter cloth. The disks are secured to a hollow center tube, and the tube and disks mounted in a cistern. The water is admitted to the cistern, filters through the cloth, leaving the deposit on the outside, passes inside the hollow disks to the center tube, and is delivered outside the cistern. When cleaning is necessary, usually once a day, the disks and tube are revolved by means of gearing provided for this purpose, jets of water play on the disks, and the deposit which has been arrested is washed off in a few minutes, passes down a waste pipe, and filtering can be resumed. The advantages claimed by this system of filtering are that the filtering medium is cheap, it is arranged vertically, and takes up little room, and is readily cleaned by mechanical means.

Henry A. Rowland.

BY CARY T. HUTCHINSON.

GREAT as the services of the late Professor Rowland unquestionably were to pure science, yet I believe it is a moderate statement to say that no man has done more of permanent value for applied electrical science than he. He is unquestionably the father of the magnetic circuit, antedating the Hopkinsons by many years. He is the inventor of the first drum-wound armature, commonly known as the Siemens, antedating Gramme and Siemens by two or three years. He did more to establish the correct value of the ohm than any other man, and was from the first the leader in all efforts looking toward the systematization of electrical units and the determination of correct values. In a closely allied field, his is the accepted value of the mechanical equivalent of heat. These are a few of his notable works.

Professor Rowland's determinations of the ohm, of the conductivity of mercury, and the mechanical equivalent of heat are known to every one, but his position as the father of the magnetic circuit is not so generally known.

In 1873, ten years before the rest of the world had even a conception of anything beyond magnetic "poles," "susceptibility," "volume density," "surface density," "intensity," "moment," "fixed" and "free" magnetism, and the rest of meaningless and brain-wearying jargon of mathematical fluids, he announced in clear and simple terms the law of the magnetic circuit, in the form of

$$Q = M/R,$$

where Q stood for the number of lines of force, M the ampere-turns, and R the magnetic resistance, which he correctly defined as depending on the length, cross-section and permeability. The whole law was clearly stated, experimental data on rings were given, and results were plotted in terms of our modern co-ordinates $\mathfrak{B}$ and $\mathfrak{H}$. At the time he thought little of this, supposing everybody knew it, although it was contained in a paper thrice rejected by the *American Journal of Science*, only to be warmly received and praised by Maxwell.

Ten years later, in 1884, no other person having even advanced to his point in the interval, he applied this law specifically to the magnetic circuit of a dynamo in the exact form in which it is now used. His equation was of the form

$$\phi = NC / \left[\frac{L}{S\mu} + \frac{L}{A + p}\right]$$

where ϕ indicated the number of lines of force, NC the ampere-turns, $L/S\mu$ the magnetic resistance of the iron parts and $l/(A+p)$, the magnetic resistance of the air parts, p being a quantity added to A, the area of cross-section, to take account of leakage. It is needless to say that he analyzed each term correctly and pointed out that the parts depending on μ could be best found from permeability curves of the iron. In a word, he stated completely the present theory of the magnetic circuit as applied to dynamos, commonly attributed to the Hopkinsons, who worked it out in greater detail two years later. This, too, was to him a matter of no especial moment, and he has never made any especial claims in the matter.

His was the first direct-current drum armature ever built, antedating the Gramme and Siemens some two years. This machine, still in existence, was designed and built in 1868-9. It was a self-exciting machine, with a solid, stationary armature core, about which the armature coils revolved. He used this construction to avoid foucault and hysteresis losses, as he carefully explained. Nor was this invention pushed; in fact, he gave it no thought.

Another valuable service that Professor Rowland rendered to the electrical engineering profession was the stand he took in the matter of his professional fee with the Niagara Company. He was retained to make a comprehensive report on this project, at a time when little or nothing was known of electrical transmission of energy. After spending some eight months on the work, he asked for a fee, very moderate, when viewed in the light of his great ability; in fact, at the time I advised him to make his fee twice as great. He received from the company a check for one-third of the amount, with the statement of their distinguished counsel that he considered this sufficient and would pay no more. This insult hurt Professor Rowland greatly. He was tenacious of his personal dignity, and resented this contemptuous treatment by a man whose own fees were many times as great for work requiring a grade of intelligence commonplace compared to his own. So he brought suit for the fee and won his case.

This case illustrated several salient traits in his character. As all his friends know, he was a man of perfect simplicity and absolute truth. His mind was as devoid of guile as an infant's, and this frequently led him to make statements that to a stranger seemed egotistical, while in reality they were merely the truth as he saw it, and no less the truth in that they concerned himself. When the present Ambassador to England asked him some question regarding his membership in scientific societies, he named a half hundred or so, and among them that of foreign fellowship in the Royal Society of Great Britain. Asked to explain the difference between his status and that of an English engineer concerned in the case, he said that the Englishman was one of some thousands, many of them very ordinary people, and he one of three in America. Again, asked to name the half dozen greatest living scientists, he mentioned Helmholtz, Kelvin, Rayleigh (I think), and himself. On further questioning, he declared that there were no others in that rank! This was not what the suave counsel had expected, and he dropped the matter, with a laugh decidedly against him. This was not egotism or vanity. He was under oath and he told the truth as he knew it. Moreover, it was and is the truth, as others know it.

To exhibit the difference between the value of his recommendations and those of the English engineer referred to, he prepared a large chart with parallel columns showing his recommendations, the Englishman's, and the plan adopted. There were some 12 counts, on 10 of which he and the Englishman disagreed, and two where they agreed. On every count where they disagreed, Rowland was adopted, and where they had agreed a still different plan was followed.

Professor Rowland was not a routine teacher. His peculiarities of temperament prohibited the painstaking patience necessary for this. His lectures were a series of fertile suggestions. If a man chose to work them up he could get an insight into the workings of a master mind, but he must work. He was intolerant of stupidity. No merely worthy, hardworking student, without brains, had a

chance with him. A student to be tolerated must have a quick comprehension.

He was fond of society, and he loved fox hunting and sailing. He presented a rather amusing figure on horseback. His seat was not graceful, but was good, and he was frequently in at the death. His glasses, lightly poised on his nose, were held by a silk cord around his neck, and frequently came off when riding in the woods. He used to say that every tree in the country was decorated with his eyeglasses.

Professor Rowland is conceded to have been by far the ablest photographer in this country. His was work requiring the finest scientific knowledge, and he had lenses specially made to accord with his ideas. The results were the admiration and despair of all who saw them. Some of his photographs of cloud and water effects are marvelous in the definition of all parts.

He was a lover of the best chamber music—Beethoven, Bach, Chopin, and although a cultured man, he cared little or nothing for literature. Scientific books were his chief reading.

I was associated with Professor Rowland in much of the important work in his laboratory from 1886 to 1889. The late Gilbert Wilkes and I were the only ones ever allowed to conduct experimental work in that sanctum sanctorum—the constant temperature vault where the grating machine is. There were two rooms, the second not in use. We were making a determination of the conductivity of mercury and constant temperature was essential, and after much thought he permitted the work to be done in this second room, on condition that I should go down and come up only once a day. The determination was satisfactory, but all gratings ruled during that period were worthless. Our presence in an adjoining room with door closed disturbed the temperature so much that a good grating was impossible.

The newspapers have recently said that the art of ruling gratings is lost, and that Professor Rowland's secret died with him and with Schneider, his mechanic for many years. This, of course, is incorrect, and would be so even if no gratings were made elsewhere. The machine is there. A little education will readily develop another Schneider, and gratings will be as good as before.

As a presiding officer at scientific meetings he was not an unqualified success. His mind was too quick for the verbose utterances and tedious reasoning of the usual extemporaneous speaker, whom he would cut short, without ceremony, stating in a few words the idea of the speaker, and then frequently telling him he was entirely wrong.

His faith in his own work was profound. When he had demonstrated to his satisfaction that a thing was so, only the most positive disproof was of avail. He was not a respecter of traditional ideas, and mere authority carried no weight with him. His confidence in his own work was shown many times during the tedious and delicate work that I did under his direction on the magnetic effect of a moving static charge. He had made the great discovery of this fact in Berlin in 1876, but was unable then to make a quantitative determination whether the amount corresponded to theory. This task was delegated to me; it required from September to March to eliminate all the sources of error in the apparatus, and many times during these months I announced positively to him that no such effect existed; yet he did not for an instant doubt his own observations, made with cruder apparatus 10 years before. In the end he was proved right, not only in the existence of the effect, but in its amount. I see that recently some doubt has been thrown on this work by German and French experimenters, but nothing can shake the confidence acquired from him in the conviction that he is right and all the rest wrong. His experimental methods were wonderfully ingenious. He was great as a physicist, a mathematician and a mechanic. Armed at all points, he was seldom at fault. In him the world has lost a great scientist, probably the greatest this country has yet produced.

Cameras at the Pan-American.

Under certain restrictions photographs may be taken at the Exposition. The regulations restricting the use of cameras on the grounds of the Pan-American Exposition, under the concession granted to C. D. Arnold, provide that no cameras exceding 4 by 5 inches shall be allowed within the gates. Stereoscopic cameras and tripods will not be admitted under any circumstances. The fee for the admission of cameras 4 by 5 inches or under will be 50 cents for a day, or $1.50 for a week.

Murray Page Printing Telegraph.

It will be remembered that at the meeting of the American Institute of Electrical Engineers on Jan. 25, 1900, Mr. William B. Van Size, described the theory and principle of a page printing telegraph system invented by Mr. Donald Murray, an Australian journalist. During the past week the editors of ELECTRICAL WORLD AND ENGINEER were permitted to witness a practical test of the system in the Postal Telegraph Company's building. The system is very ingenious, and is developed to a high degree of perfection. What it accomplishes may be stated briefly as follows: The messages are first transcribed on a typewriter, which perforates a tape; the tape is then passed through a transmitter similar in design to the Wheatstone transmitter, and the messages are thus transmitted to the receiving station, where they are received in the form of a perforated tape. This is then passed into a typewriter, the keys of which are controlled by the perforations in the tape, and by operating the typewriter mechanically the messages are transcribed on the usual message blanks in Roman characters.

The telegraphic alphabet employed by Mr. Murray is of a special character, and is about 40 per cent shorter than the Morse alphabet. The keyboard perforator has for each character a separate movable lever, each character occupies an unvarying linear space on the tape, and consists of five perforated and unperforated divisions of such space. The difference in the number and succession of these sub-di-

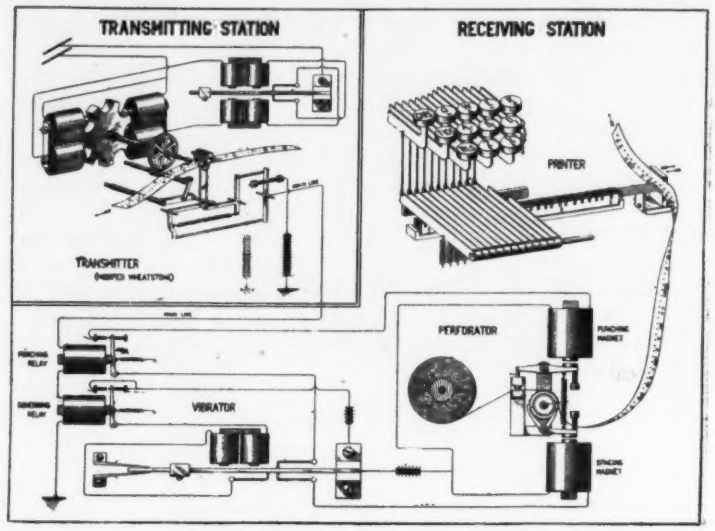


FIG. I.—DIAGRAM OF CONNECTIONS.

visions or perforations determines the characters. There are no spaces between successive letters or characters. Either makes and breaks, or reversals can be used in transmitting. It is to this fundamental fact—all letters of the same length—that the success of the system is due. Each letter occupies half an inch on the transmitting tape, and a similar length on the receiving tape. This gives a comparatively simple perforator operated by an ordinary typewriter keyboard, and there is no necessity for employing a complicated differential paper feed mechanism to provide for letters of varying length. In connection with the ordinary typewriter keyboard there is a group of 10 punches, one punching magnet, and one spacing magnet, controlling a motor-driven escapement.

At the receiving station there is an electro-magnetic perforating device which accurately reproduces the transmitting tape by producing corresponding perforations and spaces. This received perforated tape passes from the receiving perforator into the typewriter operating device. This typewriter operating device consists of five longitudinally reciprocating bars or "combs," presenting five pointed terminals to a perforated plate or die. The perforated tape passes between the surface of the perforated plate and the pointed terminals of the bars. The pointed terminals of these bars register respectively with the five holes in the die. The tape is moved along between the die and the pointed ends of the bars step by step, the length of a letter or character at each step, say, one-half inch. When perforations in the tape coincide with the pointed ends of the bars and corresponding perforations in the plate and die, and the plate is moved toward the pointed ends of the bars, the bars are or may be separated into two groups; one group is moved longitudinally, corresponding with the unperforated sub-divisions of the tape, the other

group project through the perforations in the tape and in the die, and are unmoved. Lying over the five bars or "combs" at right angles thereto are a series of thin metal strips. Each strip is mechanically connected with its individual key lever on the typewriter. The

FIG. 2.—RECEIVING TYPEWRITER.

upper surface of the five bars first described is notched arbitrarily. These notches are caused to be aligned below any one of the strips under the control of the perforated tape and die; when any one of the strips drops into a groove a motor-driven cam engages it and produces a movement of the typewriter lever. The movement of the die and paper tape and of the typewriter key-lever is produced by motor-driven cams. It is evident that this mechanism will operate not only a typewriter, but any keyboard machine such as a typesetting machine or linotype. The perforated receiving tape is therefore available for setting type automatically.

The accompanying diagram shows the general circuits and connections at both the transmitting and receiving stations.

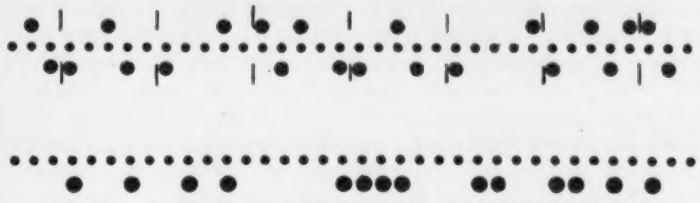


FIG. 4.—SAMPLES OF TRANSMITTING AND RECEIVED TAPE.

Synchronism between the transmitting and receiving instruments is not necessary in this system. It is, however, essential to preserve unison between the arriving impulses in the main line and the local punching and spacing impulses at the receiving station. This is accomplished in the following manner:

The governing relay operates a circuit breaker, moving between two fixed contacts, and electrically connected to the same circuit terminal, so that the moving contact in going from one to the other operates to open the circuit during its time of transit only. This break in the local vibrator circuit takes place at the beginning and end of each main line signal, and as the main line signals arrive at a uniform rate and are of unit or multiple unit duration, the governing relay operates its break-point at uniform unit intervals or multiples of these intervals. In the same circuit in which this break-point operates, there is also the break-point of the motor magnet, which works on the buzzer principle. There are thus two break-points in the same circuit. If they open and close together, then full vibratory impulses flow through the motor magnet. If, on the other hand, the rate of vibration of the reed tends to accelerate, or the rate of the arriving current signals tends to lag, then the two breaks occur more or less alternately and consequently less current gets through—the impulses are clipped—and the rate of vibration of the reed is reduced. In practice, the receiving vibrator is set to go one or two per cent faster than the rate of the arriving signals, and then the governing action of the two interfering break-points in the same circuit results in the establishment of a steady dynamic balance between the accelerating tendency of the reed and the retarding tendency of the arriving main line signals. By this arrangement the necessity for sending correcting impulses over the main line to secure synchronism is avoided, the correcting impulses being obtained locally with the co-operation of the main line signals themselves.

By varying the position of the movable weights upon the reeds at the transmitting and receiving stations the rate of vibration and the rate of transmission may be changed. To maintain unison it is necessary to have a considerable range of variation in the speed of this reed, such variation in speed to be attained in response to variation in the length of current impulses of uniform strength. This is accomplished by the aid of yielding, or spring, stops placed at each side of the reed.

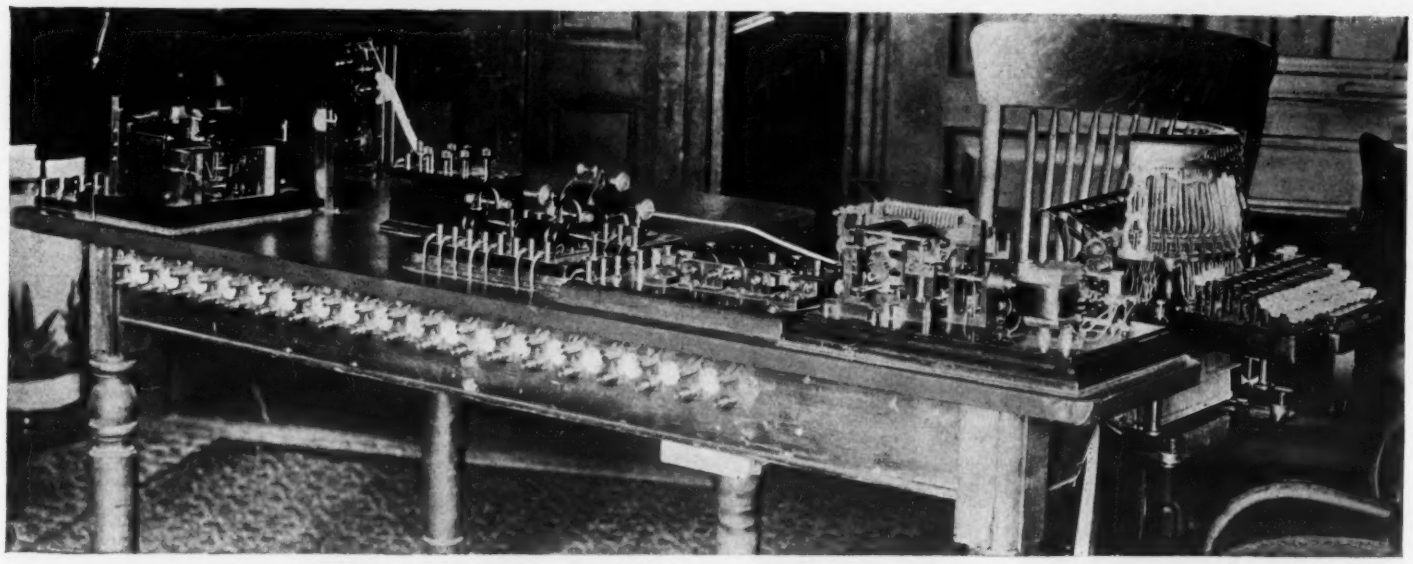


FIG. 3.—GENERAL VIEW OF PAGE PRINTING TELEGRAPH APPARATUS.

By using multiple units of current and space in the formation of his alphabet, Mr. Murray has found it unnecessary to use reversals, five different time intervals combined with makes and breaks giving all the combinations required. The uniform time for each letter is divided into five equal units or sub-divisions, one or more of these five sub-divisions being a current impulse, so that current impulses or spaces of one, two, three, four or five units duration are obtained. Thirty-two possible combinations are obtained in this manner, and by using two of these letter signals as prefixes to the others, capitals, figures and lower case letters, about 87 characters in all, may be transmitted. Makes and breaks or reversals may be used, therefore, adopting the system for use in quadruplex transmission. The alphabet, however, is only available for machine telegraphy, as it is practically impossible to observe five different time intervals with sufficient accuracy in manual transmission.

The system has been practically tested at different times on loops of varying lengths and on circuits between cities. One of the most recent tests was on April 19, on a circuit from New York to Albany and back, a total length of 384 miles. This circuit was composed of copper and iron wire, 13 miles of the circuit being underground, and 195⅛ miles in aerial cable. On this occasion, 125 words per minute were transmitted and received on the typewriter. Since that time Mr. Murray informs us that he has attained a speed of slightly over 130 words per minute in one direction. On a duplex, this means practically 260 words per minute. A copy of the message, which was transcribed on the receiving typewriter at the rate of 80 words per minute, shows very satisfactory results.

In this connection it should be mentioned that any number of typewriting perforators may be operated independently to supply transmitting tape, as one typewriter is limited in its capacity to the ability of the individual operator to manipulate the keyboard. The same applies to the translating system at the receiving station, where the tape can be cut off at convenient lengths as it is received and distributed among two or more typewriters for rapid transcription.

Modern Telephone Engineering—I.*

By Kempster B. Miller.

During the past five years a complete revolution has been worked in the circuits and apparatus of telephone exchanges, due to the introduction of the systems known under such names as "common battery," "central battery" and "central energy." These systems, when properly equipped, have proven vastly superior from both an economic and operating standpoint to the old magneto systems, wherein local batteries were used for talking and magneto generators for making the calls. The local primary battery at the subscribers' station has been superseded by a large storage battery at the central office, which also takes the place of the old magneto generator. The mechanical signal or drop has given place to the lamp signal. By these innovations the apparatus at the subscribers' station has been rendered simpler and more compact, that at the central office more reliable, and the operation of the entire system has been rendered automatic as far as the subscriber is concerned, and as much so as desirable as far as the operator is concerned. Such a system employs batteries at the central office for furnishing all current, for signaling by the subscriber and for the operation of the talking apparatus. These batteries are invariably secondary, rather than primary, for large exchanges, and operate almost universally at the voltage given by 10 cells in series, i. e., 20 to 24 volts, according to state of charge.

For charging these batteries and for furnishing current for ringing the subscribers' bells complete power plants are required, these consisting of suitable generating units, driven either electrically or mechanically, together with suitable controlling apparatus. Most companies depend upon electrical power, the charging and ringing machines being motor generators running directly from city mains.

In the modern common battery exchange the operation is such that when a subscriber removes his receiver from the hook, a lamp will be automatically lighted in front of the operator at the central office, who handles the calls of the group of subscribers to which this particular subscriber belongs. The operator in response to this signal makes connection with the subscriber's line by inserting a plug into the spring jack of that line, and after having ascertained his wants, completes the connection with the subscriber called for by means of a second plug attached to the first. As soon as a connection is thus made with a subscriber's line, the line lamp normally in control of the subscriber is disassociated from the line, but another lamp associated with the plug is placed under the control of the subscriber, this lamp being known as a supervisory lamp.

In Fig. 1 is shown a complete line circuit in diagram, including the apparatus at the subscriber's station, which is shown at the left, and the apparatus at the central office, which is shown at the right. The apparatus at the subscriber's station consists of an induction coil,

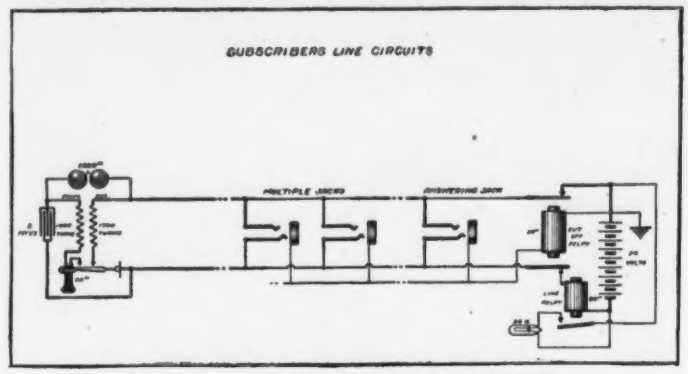


FIG. 1.—DIAGRAM OF COMPLETE LINE CIRCUIT.

a receiver, a granular carbon transmitter, a two micro-farad condenser, a 1000-ohm bell and an automatic hook-switch mounted in a suitable manner. It will be noticed from the diagram that the circuit between the two sides of the line is held open to direct currents by the condenser, and to all currents by the hook-switch contact, while the receiver is on the hook. This leaves the bell in operative relation to the line, for the purpose of receiving calls; the path of the ringing current, which current is, of course, alternating, being through one side of the line, through the bell and condenser to the other side of the line. When the receiver is removed from its hook, the circuit between the two sides of the line is closed, allowing the passage of direct current through the secondary of the induction coil and the transmitter in series. At the same time another circuit containing the transmitter, the receiver, the primary of the induction coil and the condenser is closed. The object of this latter circuit which is local to the subscriber's station, will be pointed out later.

At the central office, in addition to the answering jack and the multiple jacks, there are two relays, one termed the line relay, which is normally in circuit across the line in series with the 24-volt storage battery common to all lines, and the other termed the cut-off relay, which is in an auxiliary circuit, and is adapted to open the circuit through the line relay and the battery as soon as a plug is inserted into any jack belonging to its line. Under normal conditions, both relays remain unoperated and the conditions are as shown. As soon, however, as the subscriber removes his receiver from its hook, the circuit between the two sides of the line is made complete at the subscriber's station, and the current at the central office ener-

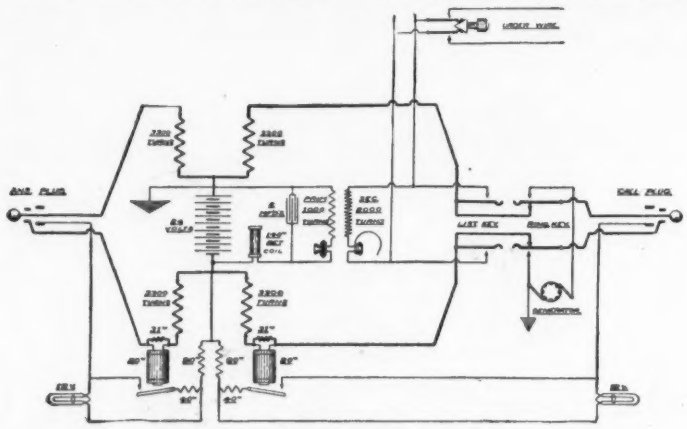


FIG. 2.—DIAGRAM OF CORD CIRCUIT.

gizes the relay and closes the circuit containing the line lamp and the battery. This lamp is located in immediate proximity to the answering jack, and the operator, seeing it illuminated, inserts a plug into the answering jack in response to the call. This plug is one of many pairs within the reach of the operator and has three contacts, two of which, the tip and sleeve, are adapted to engage the two springs of the answering jack, and thus complete the talking circuit. The

*Abstract of a paper read at the February meeting of the New York Electrical Society.

third is adapted to engage the ring contact of the jack, and being in connection with the live side of the battery, causes a current to pass from this side of the battery through the ring contact of the jack and the coil of the cut-off relay back to the other side of the battery. The energization of the cut-off relay serves to open the circuit of the line relay, as already described, and this, when operated, extinguishes the lamp.

One of the cord circuits is now shown in Fig. 2. In this the answering and calling plugs are shown at the extreme left and right-hand portions, respectively, each having, as before said, three contacts, two of which, the tip and sleeve, are connected by wires shown in heavy lines, which form part of the talking circuit, and the third of which is connected through the supervisory signaling apparatus to the live side of the battery, as shown. The tip and sleeve sides of the answering plug are connected together through the two halves of one side of a repeating coil, between which is connected the common battery. In the same manner the tip and sleeve strands of the calling plug are connected by the two halves of the other winding of the repeating coil between which is connected to the same battery.

This repeating coil, and there is one of them for each pair of cords and plugs, has four windings, each having approximately 3330 turns, all of these windings being on the same magnetic core. It is evident that these connections allow direct current from the storage battery to pass out over the metallic circuits of the two connected lines to energize the transmitters. A fluctuation in the current flowing in either line will, however, by induction between the windings of the repeating coil, cause a corresponding fluctuation in the current of the other line. In this way conversation between two connected lines is made possible, it being by induction rather than conduction.

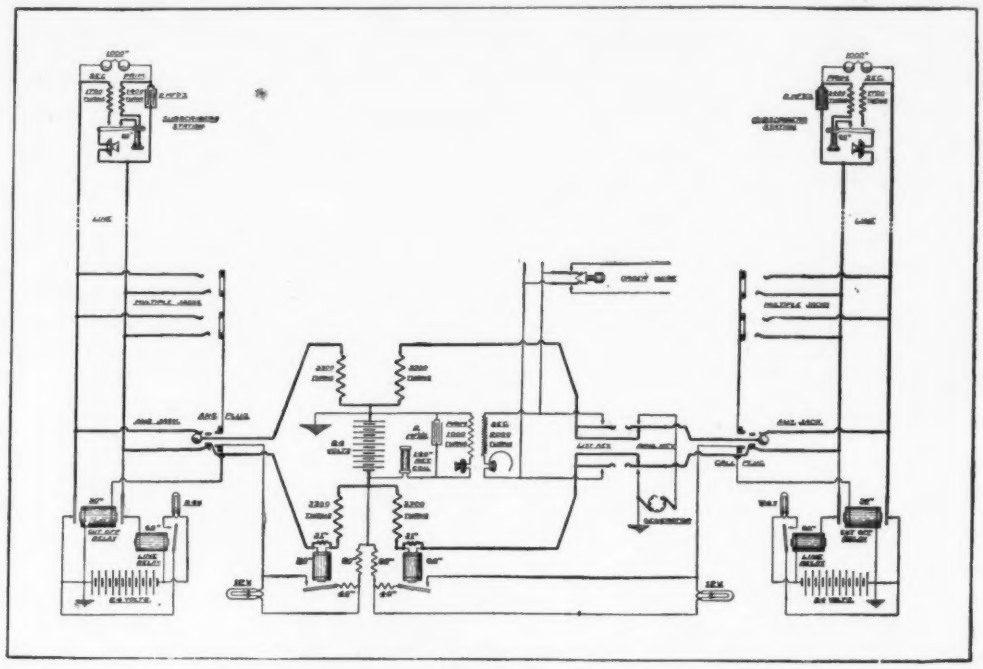


FIG. 3.—DIAGRAM OF CIRCUITS.

In the sleeve strand of the cord of each plug is connected a supervisory relay, which is energized, as is readily seen, only while current is flowing over the line to which the corresponding plug is connected, i. e., while the receiver of that line is off its hook. These relays control the circuit of supervisory lamps by the illumination of darkness of which the operator is enabled to ascertain the condition of the connected lines. On the right of this figure are shown the ringing and listening keys. The former is a device for switching the alternating current generator into the circuit of the calling plug and its connected line; the latter connects the operator's head telephone, which is shown in the center of the diagram, across the two sides of the cord, in order to enable the operator to communicate with either subscriber.

The operation of this circuit and apparatus can best be understood by referring to Fig. 3, which shows two subscribers' lines equipped as already described, connected by a cord circuit at the central office. Consider the line at the left to be that of the calling subscriber and that at the right the called. In the first place, the removing of the calling subscriber's receiver from its hook illuminates the line lamp, which remains lighted until the operator answers by the insertion of the answering plug into the answering jack. The operator, before inserting the calling plug into the jack of the called subscriber, must ascertain whether or not the line of that subscriber is already busy. This is automatically accomplished, for upon the touching of the tip of the calling plug to the ring contact of the multiple jack, she will get a click in her head telephone if the line is busy, and silence if it is free. If the line is free, she inserts the plug to its full extent, and presses her ringing key, which rings the subscriber's bell. As soon as the calling plug is inserted the supervisory lamp, shown at the right-hand lower portion of the figure, will be illuminated, because its circuit will be completed from ground through the battery, through the 90-ohm resistance coil and the lamp; thence through the third strand of the cord, the test ring contact of the jack, and to ground through the cut-off relay. This current will not only illuminate the lamp, but will operate the cut-off relay of the line called for as well. As soon as the subscriber of this line responds, he will close the circuit between the two sides of his line and thus allow current to pass over the line to operate the transmitter. This current will pass through the supervisory relay, which will then be operated to close the low-resistance shunt about the lamp and thus extinguish it. Both lamps are now out, and the operator pays no further attention to the connection until she sees one or both of the supervisory lamps again lighted. The corresponding lamp will be lighted when one or both of the subscribers hang up their receivers, which act will, by opening the circuit of the line, cause the corresponding supervisory relay to let go of its armature and thus remove the shunt about its lamp. When both lamps are thus lighted, the operator knows that the connection is no longer desired, and without further inquiry pulls down the plugs.

It is evident that any fluctuation in the resistance of the current of a transmitter at one subscriber's station will cause a corresponding fluctuation of the current flowing in the line, and this fluctuation will pass through the two windings forming one side of the repeating coil, which will act inductively on the two windings forming the other side of the repeating coil and produce a corresponding fluctuation in the other line. This latter fluctuation will pass through the secondary winding of the induction coil and the transmitter at the subscriber's station, and induce a corresponding fluctuation in the local circuit containing the receiver and the condenser.

One of the functions of this local circuit, which has already been referred to, is that of putting the receiver in inductive relation to the line without subjecting it to the passage of direct current through it, which circumstance might tend, if the receiver were connected up the wrong way, to demagnetize its magnets. This local circuit is, however, designed to accomplish still another result, this being the formation of a comparatively short path, through which the fluctuations set up by the transmitter may more readily pass; in other words, it is supposed to act as the local circuit of a sort of a booster to the outgoing telephone currents. The fluctuation in current caused by the transmitter pass through the condenser and primary winding of the induction coil, and thus induce on the secondary, which is in the line, fluctuations which tend to increase the fluctuations directly produced in the line by the transmitter.

So far, only such means have been described as would admit of the connecting of two subscribers whose lines terminate in the same exchange. Where several offices are used in the same system, the connections between subscribers in different offices are, as has already been pointed out, made by trunk lines extending between the offices. These trunk lines are spoken of as outgoing or incoming, according to which end of them is referred to. Thus an outgoing trunk line at one office would be an incoming trunk line at another. The distinction is obvious. The outgoing trunk lines usually terminate in jacks, in the regular sections of the multiple switchboard, while the incoming trunk lines usually terminate in plugs and cords and special apparatus, arranged at special incoming trunk sections.

which sections are provided with multiple jacks in the same manner as the regular sections.

In Fig. 4 I have shown the circuits of a trunk line. The outgoing end of it at one office being shown at the left of the dotted line, while the incoming end, with its accompanying apparatus, is shown at the right. This circuit is somewhat complicated and will be better understood in connection with Figs. 5 and 6, which show a subscriber in one exchange connected through the local cord circuit at that ex-

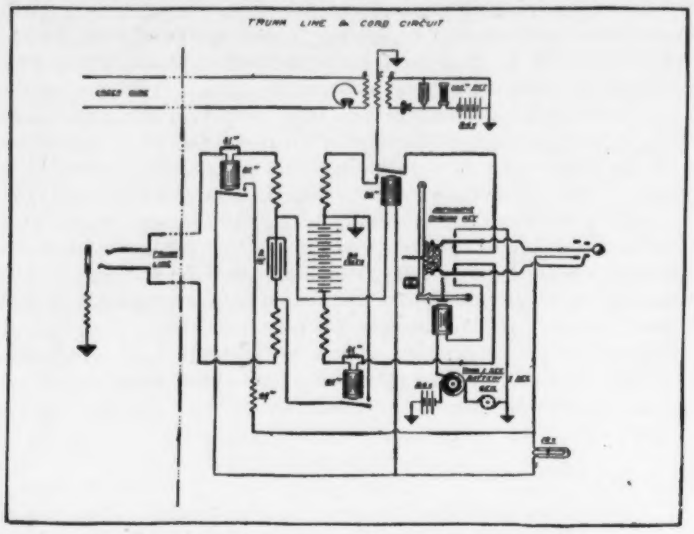
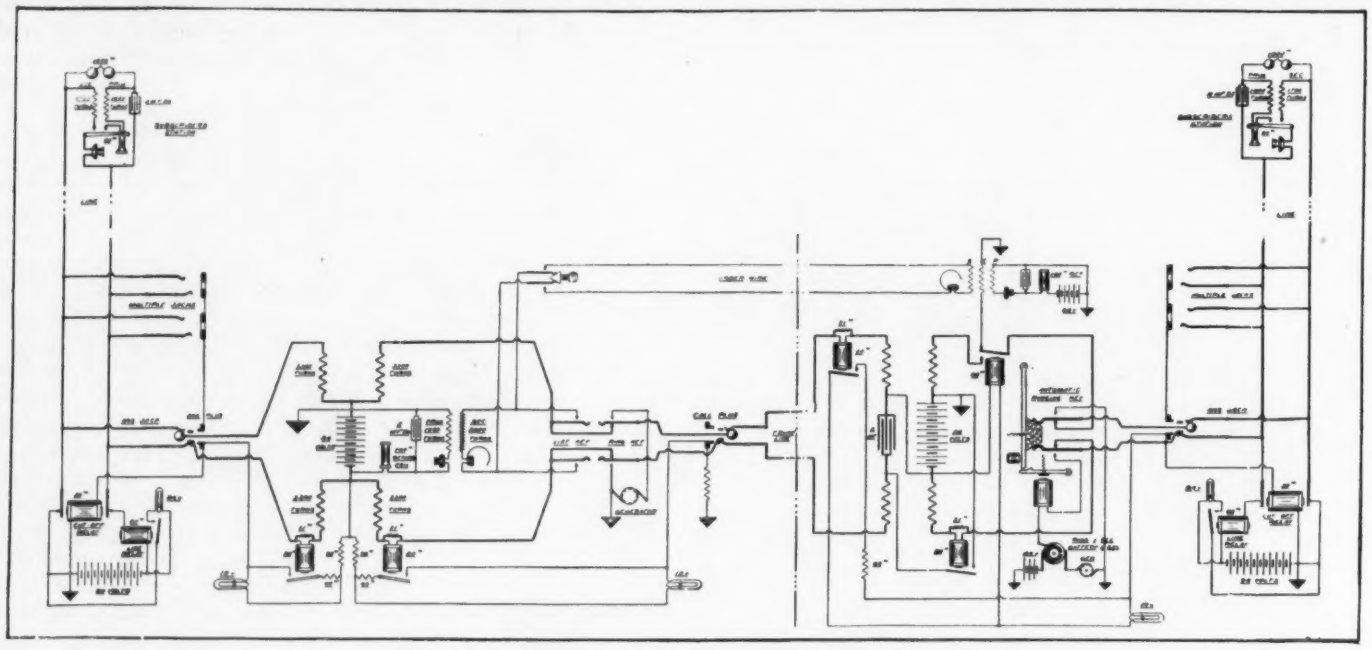


FIG. 4.—DIAGRAM OF TRUNK LINE AND CORD CIRCUIT.

change, and a trunk line with a subscriber at another exchange. Assuming that the subscriber at the left has sent in a call, the operator at one of the regular sections of the switchboard will answer it in the ordinary way by inserting a plug into the answering jack, and having learned that the connection desired is for a subscriber in another exchange, she presses her order wire key and communicates over the order wire with the incoming trunk operator at one of the incoming trunk sections of the branch exchange. The incoming trunk operator repeats the order and gives the number of an unused trunk line to the operator at the first exchange. The incoming trunk operator at the second exchange then tests the line in the ordinary way with the trunk line plug, and if it is found free, she completes the connection by inserting the plug in the multiple jack of that line. As soon as this operator completes the connection, she sets the automatic ringing key, shown just to the left of her plug, which locks in the ringing position, because its controlling relay is not operated. The ringing generator is provided with an interrupter, each revolution of which switches the ringing current on to the line for one second and the 24-volt battery on to the line for five seconds. Thus the subscriber's bell rings for one second of every six until he removes his receiver from its hook. When he does this, the current from the 24-volt battery or from the ringing generator, whichever happens to be in circuit, passes through the primary magnet of the ringing key, and trips the latter into its normal position. By this means the bell of the subscriber is rung at intervals until he responds without any further attention on the part of the operator.

The insertion of the trunk plug into the jack of the called subscriber's line allows current to flow from the battery through the test relay and disconnect lamp, shown at the extreme lower right-hand portion of the figure, and thence through the cut-off relay to ground. This does not light the disconnect lamp, because that lamp is already shunted by the armature of another relay contained directly in the trunk line circuit, this latter relay having been operated by the insertion of the plug into the trunk line jack at the other exchange. As soon as the ringing key is tripped, the current from the battery at the incoming end of the trunk line flows through the metallic circuit of the subscribers' line to furnish current for talking. This operates the supervisory relay in the incoming cord circuit, and puts a ground on the sleeve side of the cord circuit at the first office, thereby operating the calling supervisory relay at that office, and this shunts the corresponding supervisory lamp and extinguishes it, thus showing to the regular operator at the first office that the subscriber has responded. As soon as the subscriber called for hangs up his receiver, the supervisory relay at the incoming trunk section lets go of its armature and removes the ground from the sleeve side of the trunk line. This causes the calling supervisory relay at the first office to let go of its armature and remove the shunt from around the corresponding lamp. When both lamps of the regular pair of cords at the first office are lighted, the operator at that office pulls down the connection. By thus removing the calling plug from the trunk jack, current ceases to flow in the trunk line relay at the second office, which removes the shunt from the disconnect lamp at that office and allows it to be lighted for the first time. This is a signal for the incoming trunk operator to disconnect.

It will be seen from the above circuits that when two subscribers are connected over a trunk line, they are under the control of the originating operator. The disconnect signals from both subscribers go direct to this operator, and it is not until she has pulled down this connection that the disconnect signal is given to the operator at the other exchange. The later operator has no means of listening in on the circuit.



FIGS. 5 AND 6.—DIAGRAM OF TRUNK LINE CIRCUITS.

The Society for the Promotion of Engineering Education.

This society will hold its ninth annual meeting at Buffalo, N. Y., on June 29, July 1 and 2. These dates immediately follow those of the convention of the American Society of Civil Engineers at Niagara Falls. Mr. Henry S. Jacoby, of Cornell University, is secretary of the society.

Electricity in the Sandwich Islands.

BY F. E. GRAIN.

I FIRST visited the Sandwich Islands in 1899, at a time when the city of Honolulu was filled with troops enroute to the Philippines. I carefully investigated electrical affairs and found that the progress made was not very marked, although electric lights and power plants had been installed. The city was liberally lighted with electricity and promoters were then introducing plans for the development of the electrical business by establishing electrical street car lines, putting bells into homes, adopting electrical fans, heating devices and the like. This advancement has been steadily in progress, until to-day, when the islands were visited again by your correspondent, it was discovered that not only electric lights were in service to a larger extent than ever before, but electrically driven vehicles were in use, devices for heating by electricity could be found, while electric bells, the telephone and the telegraph had made exceedingly good headway.

I interviewed some of the leading officials of the city of Honolulu, and also spoke with mine owners and proprietors of manufacturing properties in the interior. All of the people of the tropics like the electric light. For many years they have been obliged to use the petroleum oil or candle light, both of which are productive of heat to such an extent that a person cannot very well sit in a room or office in the evening lighted in this manner without suffering from the heat. Along the coast lines of the group which can be reached by wires, and which are subject to shipping, electric lights in signal towers and lighthouses have been liberally provided. I know that in coming into the harbor of Honolulu at night that I saw electrically lighted stations along the coast lines for many miles. When I was here before, only main thoroughfares of Honolulu were lighted by electric lights. Now even the remote streets are thus lighted. Besides this, circuits have been run to the suburbs and to adjoining towns, so that the entire island on which the city is situated is well illuminated at night. The stores of the city have long since put in electric lights. They believe in plenty of light and in advertising with electrical signs. During an evening patrol of the streets on which the leading mercantile houses are located, one will observe very many colored electrical signs of neat design. The mechanical advertising devices are in most instances made here, and I visited one shop in which the workmen were very busy applying mechanisms to advertising signs for the merchants of the city.

I took occasion to visit a number of the machine shops, woodworking establishments, foundries, brick works, cork cutting shops and mills of all sorts, and although in most cases the capacity of the works is small as compared with what we are used to seeing in America, the owners have taken the precaution to put in electric lights. The manufacturers of the country have not had the advantage of good power and transmission facilities and machinery and furnishings of all kinds are short in supply. The result is that the shops and mills are small, lacking in power mechanisms, poorly furnished with modern machinery and fittings, but still fairly well lighted. It looks strange to see great, white lights burning in little one-horse manufacturing apartments in which the machinery is small, often crude and sometimes entirely absent. Electric lights have also been installed quite freely in the houses of the richer classes. I visited some of the houses of the aristocracy and observed the neat arrangements of lights. Everybody lives outdoors in these climes, and the lights in some cases were arranged for both the interior of rooms and the exterior, so as to throw light on porches, grounds and perhaps street fronts. This is arranged by cutting through the walls of the building and inserting glass globes in the masonry or woodwork. The globe fills the space, and when the light is furnished for it and lighted the reflection is, of course, cast both ways.

I found that considerable demand prevailed throughout the tropics, and especially in Honolulu, for electrical heating and cooking devices. It may seem strange that heating apparatus is needed in the tropics, but there are times when storms occur and when for special reasons heating devices are needed, that some sort of a stove is convenient. Several dealers in electrical supplies informed me that they had had calls for electrical cooking apparatus. The application of the electric stove to the sub-tropics is, of course, feasible, for it is in hot climates that such a stove can be used to the best advantage. The present custom of cooking involves the use of stoves, furnaces and devices constructed by hand from stones or clay. The higher classes use imported stoves or oil burners, while at the houses of the middle and lower classes the writer saw some very curious cooking apparatus. Some of it is nothing more than several flat stones arranged in such way that a fire can be made between them and the portions to be cooked are placed above. These stones get heated and retain the heat for a long time, producing discomfort in the houses. If electrical heating and cooking devices were sent to the agents in Honolulu, it would be found that a good demand would prevail very promptly. There are no such stoves in the stores now, but I was told that some would be secured and advertising literature distributed concerning the same upon arrival.

The Hawaiians seemed to me to be especially interested in new inventions and improvements in electrical lines. I know that in cases where electrical bells have been put in, the members of the household are extremely proud of the same. I had occasion to call upon a family, and as I approached the house I observed that the enitre family which was seated on the porch entered the house when they saw me approaching. I wondered at this, until I was told later on that they did this so that their visitor would have to use the new system of electrical bells which had been put in. I am informed that when the bells are first installed, the members of the household amused themselves by ringing the bells continuously for hours at a time. Electricians who put in bells tell me that they can get plenty of orders by canvassing the districts. There is considerable

JAPANESE ELECTRICAL WORKMEN IN HAWAII.

room here for the establishing of electrical supply houses and shops for working in this line.

As in most of the tropical cities and towns, the street railway of Honolulu is not yet what it ought to be to keep up with other improvements of the city. I had already found that the street railway of Manila was poorly equipped and totally incapable of accommodating the traffic. An electric line there would be a fortune to its owners, as would a line in Iloilo. At Nagasaki, Japan, and other points in the Far East touched by myself, the need of electric street railways was very evident. In Honolulu, an electric line fitted out the same as our roads in America, would earn rich dividends for the stockholders. At present the cars are old, stuffy and far too small for service. But they could not be any larger and be drawn by the little horses here. The tracks are small and in bad form and would have to be renewed for electrically driven cars. The roads, however, are in fair condition for the operation of an electrical road. One of the principal drawbacks which I found in Nagasaki, Manila and parts of Iloilo was that the streets were too narrow and the roads hardly suitable for electric lines unless considerable work is done. Buildings would have to be torn out in some squares to give room enough to get a car around a corner, so narrow are many of the streets. But in Honolulu there is plenty of space in nearly all of the thoroughfares. The pavement is also in fair order and would not need much repairing or constructing to get into shape for street cars. As to the patronage of a line of this sort in Honolulu, there is no doubting that it would pay well from the start. The traffic of the present road is beyond its capacity and the accommodations are very poor. If such a line were established, freight cars should also be put in, for it is a part of the road's business to carry packages. I know that every time I rode on one of the little bob-tailed cars, the driver had to get down and help some market woman place her load of purchases on a rack arranged in the

front of the car. Freight all along the line is picked up. This freightage is charged for and usually at the rate of one passenger. I am of the opinion that there is an abundance of capital in Honolulu with which an electrical road and power station could be put in. The reasons for drawing these conclusions in this city are very similar to those of all other tropical possessions in which I have traveled recently. So many Americans and foreigners of other nations have come into the new possessions of America during the past two or three years, that modern customs and ideas of home are being introduced with rapidity. You would almost suppose some of these possessions in the Pacific to be American cities or towns because of finding so many Americans and Europeans in them, and because of the introduction of American ideas for running hotels, stores, commercial and general industrial industries. There are American hotels, shops, stores and works everywhere, not alone here in the Hawaiian Islands, but in the Philippines and in Japan. Under these conditions it is not strange that there should be a need of electrical lights, roads and vehicles. I concluded that any one wishing to start an electrical street railroad in Honolulu would find it best to import some circular saws, planers, tie making machinery and general woodworking devices for operation by steam or water power, or if the plant is installed, by electrical power. The power station would, of course, have to be equipped with engines, boilers and other machinery by importing the same from America or other countries.

For an electrical street road in Honolulu, water power can be employed, as there are several locations where damming can be done and turbine wheels installed for developing the required power. It is probable, however, that the plant would be operated by steam power, and for this purpose there is an abundance of wood for fuel. Fuel is cheap. Not only can wood be cut and hauled to the fireroom at a cost that would be about one-third the cost in America, but coal has been discovered, and if needed could be hauled to the furnaces. They say that the cost of this coal is ridiculously small for the reason that the natives employed at getting it out work for about 20 cents per day. The coal runs in leads which are broken, but which are taken up again after digging for a short while. The leads are followed in broken columns through the hills, and such coal as is secured is carted to the city of Honolulu. They have also located petroleum oil wells on one of the islands of the group, and I saw some of this oil in use in a furnace where they were running some lumber machinery. The boiler was 200 horse-power. The owners of the plant stated that the cost of generating the steam by this system amounted to about $1.50 per day for the 200 horse-power. Fuel is also plenty in the form of charcoal, for there are a number of charcoal plants in working condition, and the charcoal is brought to the consumers in sacks. I also saw some coke from gas works.

Mention must also be made of the electrical vehicles which have been introduced in Honolulu during the past few years. I did not notice any motor carriages when I was here in 1899, but to-day I can see quite a number of horseless carriages running about the streets, nearly every one of which is of up-to-date pattern. Several of the machines I saw run by electrical power and the owners appear to be getting good results with them. The machines are evidently made for the tropics, for russet colored shades, like umbrellas, are provided. The entire machinery equipment is made with a view of use in the tropics, where, as a rule, the roads are always dusty, and the bearings have to be protected, otherwise the fine dust will get into them and cut them. But in all of the tropical countries which I visited, I noticed little more dust than in America. There is hardly any need for bothering about the dust. In Honolulu I saw much less dust than often seen in the streets of American cities.

What will necessarily interest the owners of electrical light plants, electrical equipping houses, electrical street railway line promoters, and users of electrical vehicles, is the matter of an electrical repair shop.

There are no electrically fitted shops in the islands at present in which a specialty is made of repairing and constructing electrical machinery and devices. Nor is there any suitable electrical furnishing house. There is a great opening here for the establishing of a shop in which electrical devices of all sorts can be built and repaired. There is also a grand chance for some one to open an electrical supply store. At present, if an electrical device of any description is out of order, it is taken to the regular machinists, who may be familiar with ordinary mechanisms, but must experiment with the electrical apparatus before they can get it into running condition; in fact, I know of many instances in which these machinists have put an electrical device completely out of service through poor adjustments and careless handling. Electrical devices, as is known, cannot be trifled with with new hands, yet this is what is being done in the shops of Honolulu, in which the machinists are perfectly competent to repair farming machinery, pumps, waterwheels, sewing machines, printing presses, wagons and the like, but are unfamiliar with electrical motors anl dynamos and their fittings.

Ganz Transformers and Transformer Switches.

As illustrating European methods of transformer construction and regulation, we give below an account of several of the types of transformers made by Ganz & Co., of Budapest, Hungary, and of the automatic transformer switches made by the same firm:

The core of a 300-kw single-phase transformer is shown in Fig. 1. The type illustrated is constructed for a frequency of 25 periods, 5000 volts primary and 430 volts secondary. The core is composed of two circular columns of laminations connected at the top and bottom by horizontal laminations, thus forming a simple magnetic circuit. The base is in two parts, held together by screws, and encloses the lower part of the transformer core. The cast-iron part holding the upper part of the transformer is secured to the base by two forged iron rods. The primary coils are mounted directly on the iron core and

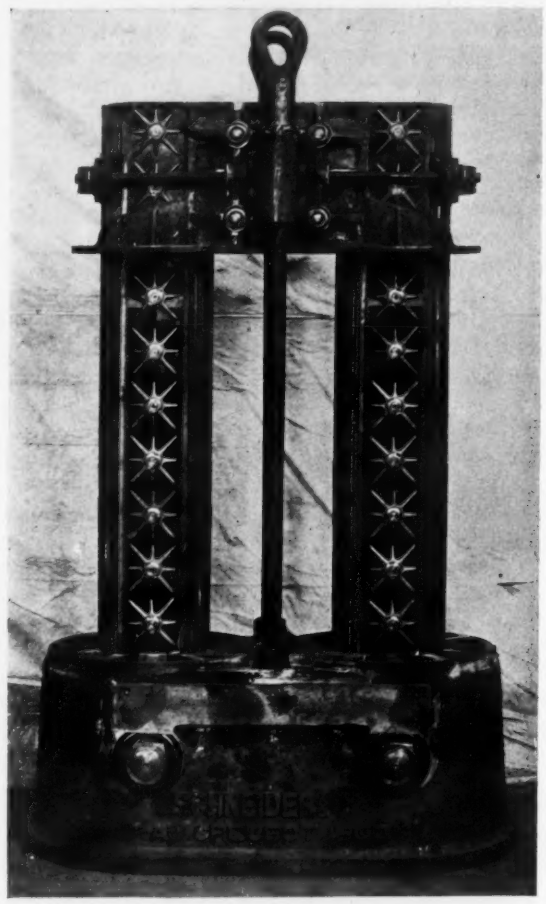


FIG. 1.—IRON CORE 300-KW SINGLE-PHASE TRANSFORMER.

are surrounded by the secondary coils, space being left for air circulation. The core is also provided with spaces for air circulation. The secondary coils are made of copper bars of 25 mms area. By arranging the coils in the above manner, the stray field is reduced to a minimum, and the primary coils, being entirely surrounded, are inaccessible to touch. By using artificial ventilation from a 1-hp centrifugal blower, the temperature does not rise more than 25 C. above the surrounding air when the transformer is loaded with 300-kilovolt amperes. The transformer weighs 8800 lbs., and has an efficiency at full load of 98.3 per cent.

Figs. 2 and 3 show a 15-kw single-phase transformer wound for a primary voltage of 2910, and a secondary voltage of 105. Fig. 3 shows a three-phase, 30-kw transformer for a 220-volt circuit, the secondary giving 200 volts. The primary and secondary windings are placed alternately. The entire weight of this transformer is 1760 lbs.

The Ganz Company makes an "Arc Lamp Divisor," or balance coil, which is in form a monophase transformer, but with a single coil placed on the middle part of the magnetic circuit. The coil is divided into three parts, each with the same number of windings, so that on a 105-volt circuit each part will have a voltage of 35, or sufficient to feed a single arc lamp. By this means three arc lamps may be operated entirely independent of each other and can be switched in or out singly. The main advantage of this apparatus is that it secures the independence of the arc lamps and makes the use

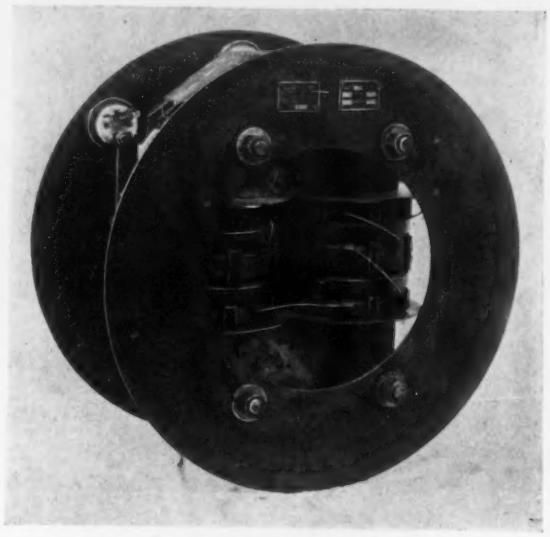


FIG. 2.—15-KW SINGLE-PHASE TRANSFORMER.

of series lamps possible without any appreciable loss of energy, which advantages cannot be secured if connected with 105-volt mains with resistance or a choking coil in circuit. The loss of energy in such a coil amounts only to 20 watts, being that required for magnetizing the iron core. Even in the most unfavorable case of one arc lamp of 12 amperes burning, the consumption of energy is only 4.8 per cent larger than what it would be if the lamp were fed direct with 35 volts.

The Ganz Company manufacture two automatic transformer switches, one for use with a single transformer and another for use with a group of transformers. The first mentioned switch, shown in Figs. 5 and 6, serves the purpose of reducing to a minimum automatically the magnetizing current in a single-phase transformer during the period of no-load.

As is well known, though the magnetizing energy of a transformer is relatively small in amount, it is, nevertheless, a considerable item in the aggregate on a 24-hour circuit. The principle upon which this latter apparatus rests is that upon the breaking of the secondary circuit of a transformer, the primary coil of a small auxiliary transformer is automatically switched in series with the primary of the transformer by the action of a balance weight. The core of the auxiliary transformer is of such dimensions that it requires very little magnetizing energy.

The secondary coil of the auxiliary transformer is switched in series with the working secondary circuit, and also with four electromagnets of different numbers of turns, as shown in Fig. 5. If

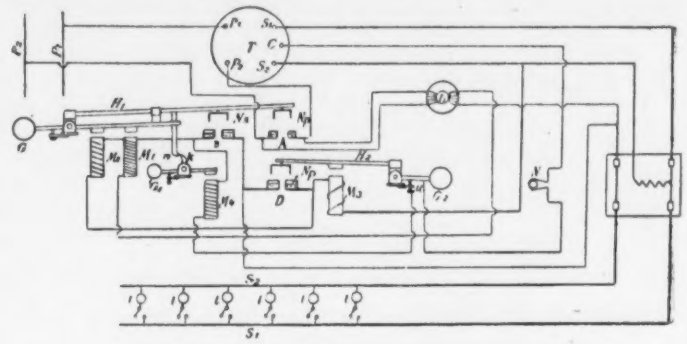


FIG. 5.—DIAGRAM OF SWITCH CONNECTIONS.

a receptive device is cut into the working circuit taking a small current, then the electromagnet having the greatest number of windings, M_1, overcomes the action of the balance weight, thereby short-circuiting the primary as well as the secondary coil of the auxiliary transformer—the working transformer, consequently, receiving the

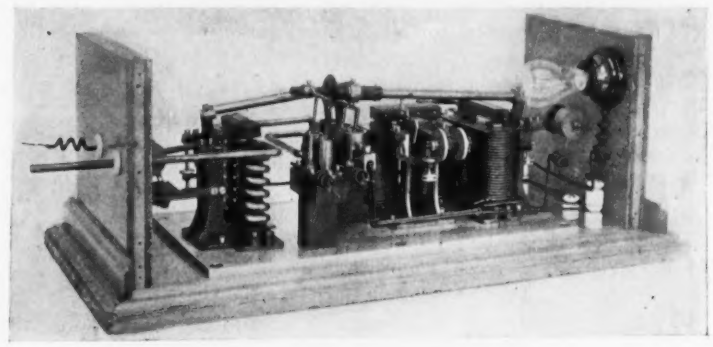


FIG. 6.—SCHLATTER SWITCH SYSTEM FOR TRANSFORMER.

full working voltage. If the secondary current reaches .25 ampere, then the electromagnet M_2 having a less number of windings will operate and short-circuit the magnet M_1; and finally, at 15 amperes the electromagnet M_3 having the least number of windings, comes into operation and short-circuits M_2. In addition to the above electromagnets there is a fourth one, M_4, having a great number of windings, which is in series with a 100-volt, 50-cp incandescent lamp, and connected with the 50-volt terminals of the working transformer. This magnet follows M_1 in operation and serves to prevent the current impulses, which otherwise would occur in the secondary circuit.

The Schlatter switch used in connection with transformer groups is shown in Figs. 7 and 8. In such groups one transformer is always in circuit while the others are automatically switched in or out according to the requirements, so that during the period of small load only one transformer is consuming energy. The switch is

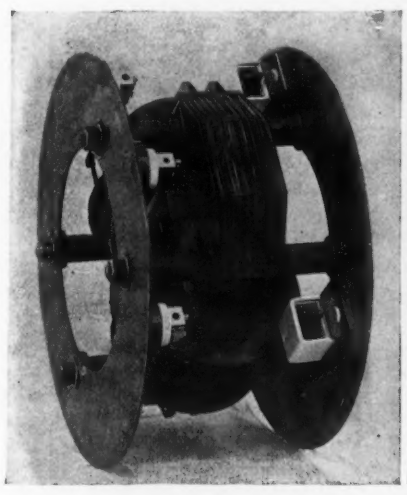


FIG. 3.—18-KW SINGLE-PHASE TRANSF.

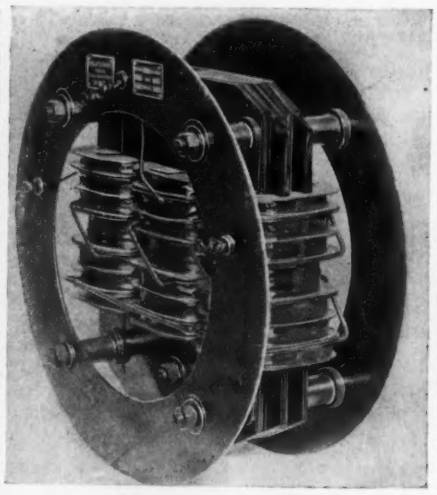


FIG. 4.—30-KW THREE-PHASE TRANSF.

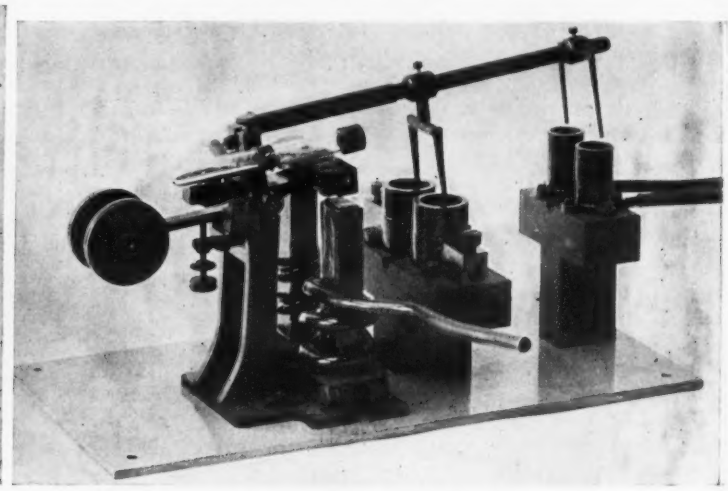


FIG. 7.—SCHLATTER SWITCH SYSTEM FOR TRANSFORMER GROUPS.

composed of a double-armed lever, *S*, provided with a balancing weight. The weight tends to keep the secondary coil of the transformer out of circuit while the electromagnet, *M*, tends to overcome the influence of the weight and to switch in the transformer coils. If the load of the secondary circuit is greater than the capacity of the transformer, then the electromagnet overcomes the influence of the weight, and when the second transformer becomes fully loaded,

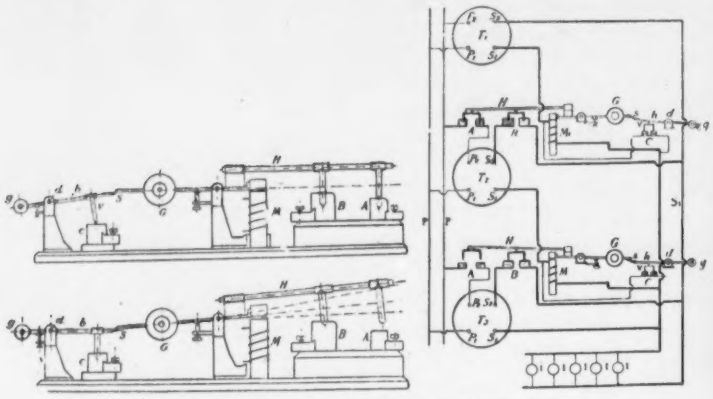


FIG. 8.—DIAGRAM OF SWITCH CONNECTIONS.

then the third unit may be switched in. Part of the details of the cut relate to mechanism for obviating vibration of the lever *S* at the moment when it switches into circuit. The illustrations represent a single switch for a transformer of 2.5 kilowatts, and a group switch for two such transformers.

Submarine Signaling by Telephony.

From time to time note has been made in these columns of the work of Dr. Elisha Gray and his associate, Mr. A. J. Mundy, in the development of a new method of coast and deep-sea signaling. We are indebted to Mr. Mundy, of the Gray Telephone Company, for details of recent tests made in Boston Harbor and vicinity, the results being very satisfactory to the officials who tested his invention as elaborated by Dr. Gray. The tests have been made on board the "Seabell," whose exterior and interior are illustrated in Figs. 1 and 2. This boat was designed and built for the purpose. She has a well-hole cut in the center of the hull, through which the bell is lowered with apparatus for ringing it electrically. A 6-hp gasoline engine drives a small dynamo. The bell is lowered into the sea through the well-hole to any desired depth by a windlass, and an electrical mechanism enables the operator to ring the bell continuously as a church bell is tolled, or to sound any desired number of strokes at will. Hence, one can send intelligible messages if each letter of the alphabet be represented by a given number. On a keyboard similar to that of a typewriter the inventors have grouped seven keys connected by wires from the dynamo to a commutator operating the bell. On a tablet, in front of the keyboard, the letters of the alphabet duly numbered are shown, enabling an operator, either on shipboard or ashore, to send any desired message. The message, "All well here," for example, would be sent in this way:

x x x A L L x W E L L x H E R E x x x

12-12-12 22-33-33 12 51-21-33-33 12 15-21-32-21 12-12-12

Instead of suspending the bell from a vessel, it may be hung from a buoy and permanently anchored under water at any depth desired, and at varying distance from the shore. In such a case, the current for operating the clapper would be brought to the bell from the shore by a light submarine cable.

The picking up of submarine sounds is equally effective. Messrs. Gray and Mundy experimented with a great variety of receivers operated pneumatically, electrically and mechanically. The simplest mode of hearing such submerged bell signals on board ship is to go below into the hold of the vessel, as close to the keel as possible without any apparatus whatever, and simply listen. At a distance of a mile or more the sound of the bell may be distinctly heard by the unaided ear, and is recognized just as any local sound might be. Placing one end of a wooden rod against the skin of the ship, the other end being held against the ear, the sound is heard at even a greater distance. A common tin ear-trumpet, screwed onto the end of a piece of gas pipe, the mouth of the trumpet being sealed by a tin diaphragm, and submerged 6 ft. under water, enables the observer, at the upper end of the pipe, to hear the submerged bell at a distance of three miles. For greater distances an electrical receiver has been devised by means of which the bell has been heard distinctly a distance of 12 miles. The submerged end of this receiver may be lowered over the side of the ship, or attached to it on either side of the bow, under the water line, like a pair of ears.

The submerged portion of the receiver is connected by wires to a telephone receiver, which may be carried to any part of the ship.

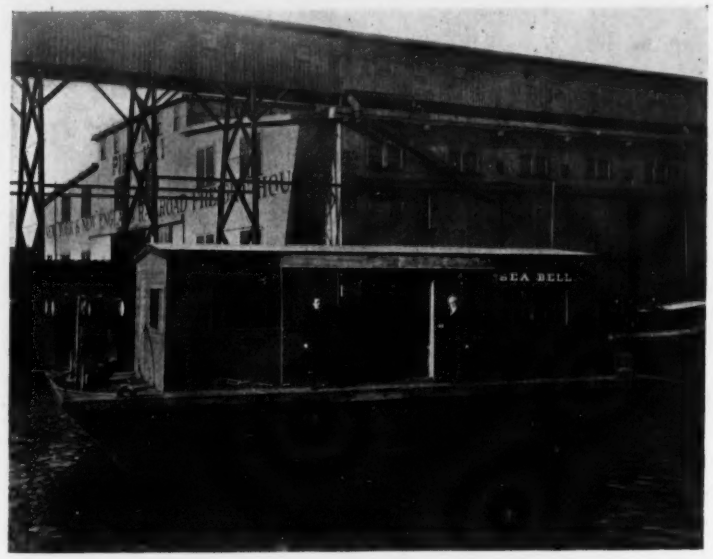


FIG. 1.—THE SEA BELL.

Professor Gray, before his death, devised an improvement for the electrical receiver by means of which a large gong will be rung automatically on the ship, whenever the submerged bell is rung. That is to say, the gong rings sympathetically, following the bell, stroke by stroke.

Mr. Mundy has invented recently an ingenious method by means of which a ship coming in from the open sea may find her way straight to the entrance of a harbor by simply feeling her way along until she finds herself in any position where the sounds from two bells, one on either side of the entrance, are heard simultaneously on board ship. These bells are placed at equal distances from the entrance and are rung by cable connection at precisely the same instant. As sound travels at a fixed speed in the water (just as it does in the air), the vessel must be equi-distant from the bells in order to hear

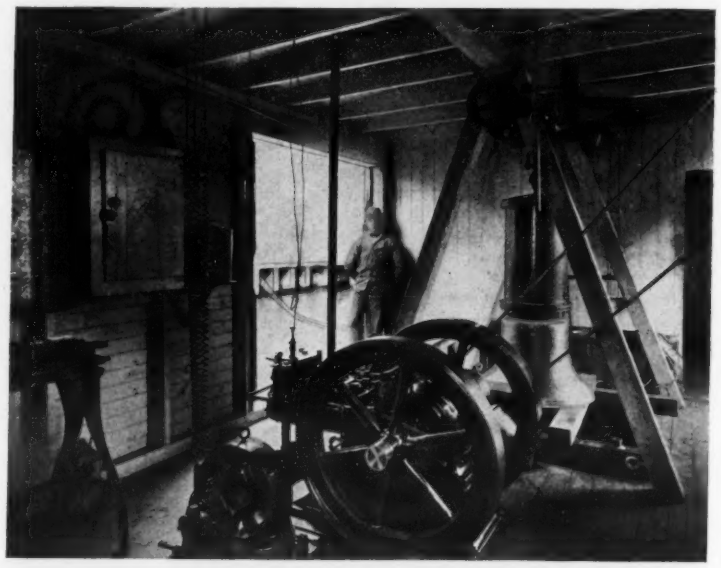


FIG. 2.—INTERIOR OF THE SEA BELL.

them simultaneously. The bells have different pitches, so that if the navigator hears the higher toned bell first, he knows he is somewhat nearer to it than to the lower toned bell, and therefore somewhat to the north of the straight line shown on his chart which leads directly to the mouth of the harbor. If, on the other hand, he hears the lower toned bell first, he knows he is south of this charted line. The length of the time interval between the two sounds will give him an

approximate idea of about how far away he is from this charted line. Thus guided, he bears either north or south, until he reaches this line where the two bells are heard simultaneously, and then his chart tells him the exact course by the compass to the mouth of the harbor, which he can maintain and verify by keeping the sound of the bells in simultaneous relation. This system does not require the use of the Gray receiver, but both methods can be employed.

A further elaboration of this principle, of "acoustic triangulation," is effected by the addition of a third bell placed in triangular relation to the other two.

Among those who have witnessed recent trials of this ingenious "wireless" system are Admiral Higginson, chairman of the United States Lighthouse Board; Naval Constructor Baxter, Colonel Stanton, U. S. A., and Constructor A. P. Nazro, the lighthouse inspector of the district. Captain L. Bayly, R. N., has been sent by the British Government to inspect and report, and the Canadian Government is also having the apparatus tested. A German engineer of high standing is also in Boston this week to make an inspection of the system.

The Trolley in Cuba.

An interesting dispatch to the New York *Evening Post* of recent date from Washington, says:

How Sir William Van Horne has been able to prosecute his railroad enterprise through Cuba in defiance of all the precautions taken by the Administration and Congress to prevent the grant of franchises was revealed by Sir William to Secretary Root, in an interview arranged by the Secretary for the purpose.

The Van Horne undertaking rests, not upon the suspended general franchise law of Cuba, which, in its clauses relating to railways, provided means for condemning lands for rights of way, stations, sidetracks, etc., by the assertion of eminent domain, but upon a special enactment, still in full operation, permitting the owner of land to construct railroads on it without any one's interference. This was designed originally for the convenience of the sugar and tobacco planters to expedite the movement of their crops; under it they have built many short lines through their own premises.

Sir William has therefore bought, or is now buying, whole farms contiguous to each other, and along the route of the trunk line which he has planned from one end of the island to the other. In this manner he has secured his right of way far more expeditiously and probably with not much more expense than if he had gone through the usual process of condemnation for every mile of the way. Moreover, every Cuban municipality has authority, still operative, to grant rights of way through and over its streets, and Sir William has taken advantage of the fact to extend his lines into the towns along the route. The municipal officers seem anxious to meet him half way, the people having risen to the notion that their future welfare depends upon their having direct access to this great artery of the island.

In short, there is just one way open to the United States Government to interfere with the Van Horne railroad programme. As the rails pass from one plantation to another, they must cross, for the most part, over public highways, which are not under local control, but are treated by our Government as military roads. To cross these it is necessary to have a written permit from Secretary Root. The Secretary has authority to grant a revocable permit, a very different thing from the investment of a permanent right like a franchise. Thus far the Secretary has declined to say whether he will grant such permits; the matter has not yet reached the stage where his final decision is necessary. It is realized here, however, that if they are once granted and trains are running, they will never be revoked, for the Cuban populace will insist upon their remaining in force.

While the pigeon-holes of the War Department are becoming stuffed with petitions and applications for railroad franchises, signed and pressed by Yankees, who boast of their "enterprise," the British subject has skipped in under everybody and bought up about everything worth having. It is understood that he has acquired this control, at an average of not more than $8 an acre for the plantations, while the municipalities have granted the right to enter the towns and villages without exacting a penny in return—sometimes, indeed, offering a bonus, when there has been a fear that some place would be overlooked on its own merits.

Elements of Illumination—XXIV.

By Dr. Louis Bell.

THE practical problem of adequately lighting the streets of a city is one which requires the local data for its solution. The amount and distribution of streets and the needs and distribution of the population are the controlling factors in the matter, and obviously these vary greatly from place to place. Then, too, the cost of lights and the funds available for the purpose depend on local conditions. In particular, the price of lights varies so much that it is difficult even to strike an average. Few topics offer less chance for certitude or are more unsatisfactory to investigate. It makes a great difference whether full arcs or half arcs (so-called) are in use, or incandescents, or Welsbachs, also whether the lights are burned all night and every night, every night until midnight or on "moonlight schedule," that is, on all nights and at all hours of the night when there is not clear moonlight. In large cities the tendency is toward the most powerful arc lights burning every night and all night, supplemented by incandescent lamps and by gas burners. In smaller cities and towns the smaller arcs are apt to be used, burned either on moonlight schedule or until 12 or 1 o'clock.

In the latitude of the Northern United States "all night and every night" public lighting usually means from 3800 to 4000 hours of lighting yearly, according to the treatment of twilight and dawn, and the weather. The moonlight schedule is carried out with various slight modifications, and evidently depends considerably upon the weather, but in practice it amounts to not far from 3000 hours per year, while lights run from dusk to midnight, or 1 a. m., usually will burn 2000 to 2200 hours per year. All night and every night lighting is, of course, the thing to be desired, but if economy is necessary, places of moderate size can be very satisfactorily lighted on a liberally administered moonlight schedule.

As between "full" and "half" arcs, the advantage economically lies, on the whole, with the former, provided the same total illumination is to be obtained in each case. The following table gives the spacing in feet required, for various radiants on an assumed minimum illumination of 0.02 candle-foot at a point midway between lights:

Kind of Light.	Distance between lights.	Lights per mile.
6.6-ampere enclosed D. C. arc....	340	15
9.6-ampere open D. C. arc.....	315	17
6.6-ampere enclosed A. C. arc....	275	19
6.6-ampere open D. C. arc.....	260	20
50-cp incandescent lamp, electric (or mantle burner)	100	53

The relative expense of lighting by these various radiants depends greatly upon circumstances not to be predicted. The price charged by lighting companies for public lighting is simply whatever the community will stand.

The relations between lighting companies and municipalities are, in most cases, mutually predatory. The former having acquired and utilized a public franchise can, in a measure, hold the streets against competition and maintain prices at the highest point that can be juggled through the city government without public scandal. The latter, through the earnest efforts of its practical politicians, can worry and threaten the former into yielding up a substantial annual rake-off in the form of jobs for heelers, contributions to campaign funds or plain cash. Occasionally simple and decent business relations are maintained.

The prices actually charged for public arc lights burned all night and every night range very widely, but usually between $75 and $125 per lamp per year. The former price is seldom reached or discounted, save in stations operated by water power or under very strong competition, and even then generally only for "half" arcs. The latter price is seldom exceeded, save where underground distribution is demanded or in case of very scattered service. Incandescent lamps of 50 candle-power, or thereabouts, usually bring $30 to $35 per year, and the former figure is a common one for mantle burners on the gas system. For equal minimum intensity of illumination there is not much to choose between the several illuminants at the prices mentioned, the choice between them being due to suitability. At the same total cost, however, the arc lights give a considerably higher average illumination, and experience shows that on the whole the arcs which have to be inspected at frequent intervals for

the purpose of trimming are kept nearer their point of maximum efficiency than either incandescents or gas burners.

The real cost of public lighting is, of course, immensely variable, since amount and price are both variable. In the average New England city most of the lighting is by arcs,and there is an average of one arc for each 175 to 200 inhabitants. The total cost of public lighting is frequently from 75 cents to $1 per inhabitant, and sometimes rises to $1.50, and even to $2 per inhabitant. It is, therefore, no inconsiderable item of public expense.

Whether street lighting should be done by contract with a corporation or directly by the municipality is one of the mooted questions of economics. In theory, it would seem that such a public service should be done by the city or town itself on the same principle that all towns own their sewerage systems and most of their water works. But while experience seems to have shown that public water works are in every way desirable the same cannot be said of gas and electric plants. The arguments pro and con are about the same in each case, yet the average results seem to be different. In some municipal lighting plants, mostly small, the economic results have been excellent, in others they have been unmistakably bad.

If a municipality could start in *de novo* and erect its complete lighting system according to the best modern practice, and run that system anything like as economically as it would be run by a private company, it could unquestionably do its public lighting at a great saving in the majority of cases. But it can rarely start and operate thus freely. It often is compelled to buy out the existing plant by

FIG. 1.—POLE TOP.

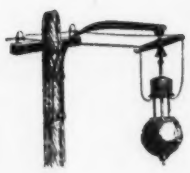


FIG. 2.—BRACKET.

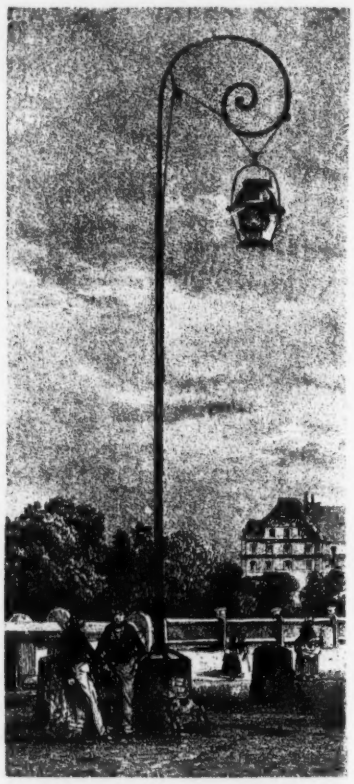


FIG. 3.—OLD POLE AND BRACKET.

law, generally at a price far larger than would suffice to erect a modern plant, for the art has been changing rapidly. It is lucky if a plant, old or new, can be secured without furnishing pickings and stealings for somebody, and in its operation the finger of the politician is too often inserted for no honest purpose.

In this matter of municipal plants statistics are even more utterly mendacious than usual, and conceal rather than disclose, the facts in the case. With respect to electrical plants at least, however owned, there is too often deliberate concealment or entire neglect of depreciation, both that due to wear and tear and the larger amount due to improvements in the art, so that from the books or reports it is almost impossible to figure the actual cost of furnishing the electrical energy. The matter may, on the whole, be summed up about as follows: If a municipality can both acquire a lighting plant and operate it at the ordinary current rates for apparatus, labor and material paid by private buyers and employers, it can effect a large saving in its cost of public lighting, but if the plant is touched by venal politics it will assuredly prove a costly failure.

Many improvements are possible in street lighting, but for the present the arc lamp must be the main reliance. At first thought the Nernst lamp would seem to offer advantages, but it does not readily lend itself to the distribution in series which is desirable in street lighting for the sake of economy. Improvements in mantle gas burners may bring them into a position of great usefulness, which they have not yet attained by reason of their rapid deterioration. But for the most part the electric arc is the most available source of light.

Contracts for arc lighting should never be drawn on the basis of a nominal candle-power. They should clearly specify the kind of arc to be installed, the amount of energy to be taken in each arc, and the kind of shades to be used. The nature of the fixtures should be specifically designated, whether pole tops, brackets, mast-arms or cross suspensions. These and the locations of the lamps should be designated by some one familiar with practical street lighting, following the general line of the data which have here been given. The hours of lighting should be distinctly stated with rebates for failure to provide continuous light within these hours. Such rebates should be merely nominal for deficiencies up to, say, 1 or 2 per cent of the total hours of lighting and punitive on an increasing scale for greater deficiencies.

The fixtures used for street lighting are of very various pattern, but fall into four general classes, pole-tops, brackets, mast-arms and cross suspensions. These have been, with the exception of the mast-arm in use for public lighting for a very long period, going back to the days of oil lamps and candles. The pole-top fixture is essentially a support for a lamp on the top of a post. In arc lighting it is generally combined with a protecting water hood to shield the top of the lamp from the weather and also to shield sometimes the individual switch for short circuiting the lamp. Fig. 1 shows a typical pole top such as is often used for enclosed arc lamps. The side rods are placed edge toward the arc to obviate shadows and the whole affair fits neatly upon the top of the pole, the arc lamp hanging from an insulated hook within the hood. The obvious objection to pole-top fixtures, whether for arc lights or for gas lamps, is that the light must be on the curb, and does not light the street properly. For open spaces where the pole can be out from the curb the pole tops work well and may be freely used.

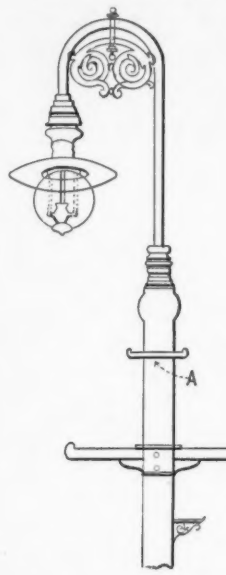


FIG. 4.—MODERN TYPE OF POLE.

A very obvious modification is the lateral bracket carrying the lamp well clear of the curb, yet not so far out as to make it difficult to trim the lamp from the pole without lowering it. Fig. 2 is a specimen of this class, which carries the lamp 2 ft. out from the pole. If longer than this the lamp should be supported by a rope and lowered for trimming. Such brackets in various forms have been in use for a long time, and a neat iron pole and bracket dating back some 75 years is shown in Fig. 3. It might be copied to advantage even now. A somewhat analogous type of bracket has been introduced and very extensively used by the Boston Electric Light Company. It is a hollow casting, fitted to the top of a neat wooden pole, and permits the line wires to be carried within it clear to the lamp without exposing them. For underground service the pole itself may be hollow, thus entirely eliminating exposed wires. The lamp can be trimmed easily from the pole, and a cut-out is fitted in the slight expansion near the base of the upright part of the casting. Fig. 4 shows this very neat and convenient fixture in outline.

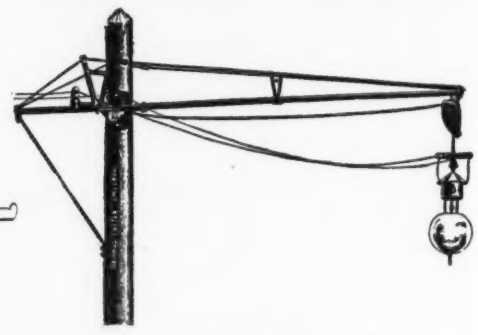


FIG. 5.—MAST ARM.

Mast-arms are really modified brackets lengthened so much as to bring the lamps nearly or quite to the center line of the street, and arranged usually to permit the lamp being readily lowered to the

street for trimming. Now and then the lamp is carried on a trolley which can be pulled in to the pole for trimming, but the preference is generally for the former plan. Fig. 5 shows a common form of mast arm fitted for lowering the lamp. The lamp is usually carried some 14 or 15 ft. out from the pole, hence the truss form becomes necessary to secure the proper degree of strength and stiffness.

Mast arms furnish, on the whole, the best means of carrying the light out over the street. They call for but a single pole at the curb, and put the light exactly where it is wanted, and hold it there steadily. They are far from beautiful, however, and from the æsthetic standpoint the cross suspension is often to be preferred. This is a very old method of supporting lights, and consists merely of a rope stretched across the street and carrying midway a pulley from which the lamp is carried. Fig. 6 from an old French print, showing street lighting in Paris early in the eighteenth century, illustrates the principle as well as a more modern instance. To-day the rope is of wire strands and the lamp is an electric arc, but the rest has changed little.

In ordinary cases the cross suspension requires a pole set at the curb on each side of the street, which, except at corners where the pole lines cross, is somewhat of an inconvenience. Sometimes a tree is used for one support, but the practice is not to be encouraged, since it is both bad for the tree and renders the lamp rather unsteady in a wind. When conditions permit cross suspension, however, is a most useful and unobtrusive method of carrying the lamps.

FIG. 6.—OLD CROSS SUSPENSION.

In general, where there is an underground distribution, either of electricity or gas, pole top and bracket fixtures are most useful for ordinary purposes. Fixtures like Fig. 4 lend themselves very readily to artistic treatment either for electric lights or for mantle or regenerative gas burners. In streets thickly shaded by trees recourse must generally be taken to mast-arms or to cross suspension in order to put the lights where shadows will not be troublesome. Sometimes even incandescent lamps are carried in the latter manner, though being rather closely spaced they, like mantle burners, give fairly good results if placed alternately on each side of the street and bracketed clear of the curb. Generally, the lighting of a town will call into useful service all the ordinary types of fixtures, and an attempt to adopt a single standard form will lead to considerable embarrassment in the effective lighting of certain localities.

An Electric Haulage System for Ships in Nova Scotia.

An interesting electrical installation of somewhat novel character has been made recently at Liverpool, Nova Scotia. It was devised for the purpose of hauling vessels out of and lowering them into the River Mersey, a distance of over 500 ft. on an incline having a grade of half an inch to the foot. Some years ago the Liverpool Marine Railway Company, Limited, had a slip of this kind in operation, whose motive power was horses. A framework carried two horizontal gears attached to which was a beveled gear with a vertical shaft projecting upward, and working on this were two long arms or sweeps. To these were hitched two or four horses traveling around on an upper platform, which was reached by a runway outside the building. This animal power was, of course, limited in its capacity, and extremely slow, it taking three to four hours to haul up a small vessel in the cradle. While the vessel was undergoing repairs, it was held from running back by a great dog in a ratchet. When the work was finished it was the custom to knock out the dog and let the cradle go "by the run" back into the water. It is almost needless to say that this crude method soon wrecked the cradle and the track as well. The result was that the whole plant fell into disuse and decay.

During the past year a new company was organized with the object of rebuilding and equipping the slip in an up-to-date manner, and when it came to the question of the best power it was decided to use an electric motor, there being, moreover, a lighting system in town driven by water power, from which the current could be obtained very

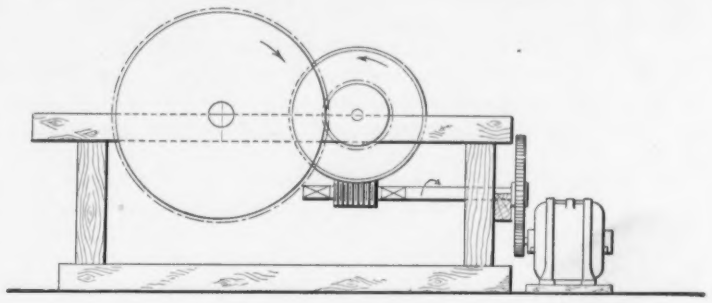


FIG. 1.—LIVERPOOL MARINE HAULAGE SYSTEM.

cheaply. A Stanley or S. K. C. 30-hp induction motor has been installed, which will raise and lower ships of a burden up to 400 tons, over a track which is 600 ft. in length, in the remarkably quick time of 25 minutes. The equipment has so far proved a very economical and highly satisfactory investment. The motor is geared to a worm, which in turn operates a further train of gears, as illustrated in Figs. 1 and 2 herewith. On the shaft of the large and last gear is a sprocket which engages an endless two-inch chain that hauls the cradle. The whole thing is as simple as possible. It will, of course, be understood that the gears and sprockets are within the frame and not outside, and it may be added that the frame is much heavier than shown. It was found feasible to use much of the old gearing. The framework was set on a bed of concrete 3 ft. deep and fastened firmly into place by heavy rods running up through the concrete and frames. It also butts against the end of the slip, so that there is not the slightest chance for it to move.

We are indebted for the data in regard to this interesting little installation, which it would seem might well be copied elsewhere, to

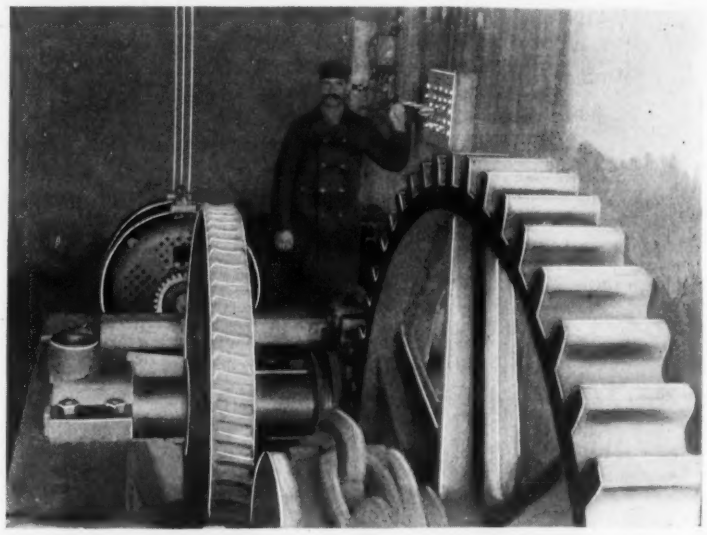


FIG. 2.—INTERIOR OF LIVERPOOL HAULAGE PLANT.

Mr. C. O. Foss, engineer of the Central Railway Company, Limited, of Nova Scotia, and to Mr. T. R. Bartling, the secretary and treasurer of the Liverpool Marine Railway Company, Limited.

Street Car Strike in Madrid.

A dispatch from Madrid, April 25, states that a strike of the street car railroad employees is in progress in that city. No cars are running, and the police are guarding the property of the company.

Electricity at the Pan-American Exposition

A General Review of the Plans Executed and Under Way at Buffalo.

THE opening of the Pan-American Exposition at Buffalo, in spite of early boasts to the contrary, finds that enterprise no nearer completion than any of the other large expositions of the past ten years at a corresponding time. But a general review of the part electricity will play and the nature of the exhibits can be made now, leaving the statement of further details to the time when the progress of the exposition work makes them possible.

In the preliminary announcements sent out by the management of the exhibition the statements were made that it would excel all previous enterprises of the kind (1) in elaborate and beautiful lighting effects, using over 300,000 8-cp lamps; (2) in the splendor of its hydraulic and fountain effects; (3) in exquisite horticultural and floral embellishments; (4) in original statuary and plastic ornamentation; (5) in the richness of its color decorations, all buildings to be tinted in beautiful and harmonious shades; (6) in the magnificence of its court settings, the court area being much larger than at any former exposition. The visitor must admit that all of these claims have been made good. It is with the first and second of these propositions that the electrical and mechanical bureau under its chief, Mr. Henry Rustin, had to deal. Mr. Luther Stieringer, whose services have become invaluable in connection with any exposition enterprise by virtue of his long experience in such work, has acted as consulting electrical engineer. The electrical features of the Pan-American Exposition have been more widely advertised than any other, which fact is sufficient proof of the important part they will play in the entertainment of the general public. Much might and will be written from a popular standpoint about the beautiful effects that have been produced, but space requires that this article be confined mainly to a matter-of-fact statement as to how they are produced.

FIG. I.—THE ELECTRIC TOWER.

The most distinctive feature of the decorative lighting aside from the great amount of power so expended is the use entirely of 8-cp lamps. Arcs are used only for useful service lighting in the buildings and about the grounds. The selection of the 8-cp incandescent lamp as the standard for decorative lighting was because of a desire to suppress as far as possible the individuality of each lamp and give the general effect that of areas rather than points of light. In this respect it marks the new era in incandescent lighting which seeks glow rather than glare. The place of honor among the buildings of the Exposition is occupied by the "Electric Tower," 391 ft. high, built expressly for electric decorative effect. Its location can be seen on the accompanying map of the grounds.

The general scheme of the main area lighting depends for its success on the arrangement of buildings with reference to the electric tower. There is a gradual increase of lighting beginning at the south end of the court, until it reaches a climax in the stately electric tower at the north end, where the lights are clustered the thickest. The number of lights and the quantity of light exceeds that of any other equal area before artificially illuminated, and as mentioned above, the light is evenly distributed. The results fully justify the expenditure for light, as the effects are truly wonderful and beautiful, and of a kind never before seen.

In the grand basin in front of the electric tower are 100 searchlights for use in connection with the fountains, but the main electric fountain is in the North Bay, as before explained. The fountains in the basin take 500,000 gallons of water per hour for their full operation. The fountain displays in the large court follow the same idea as the lighting and reach a climax in the basin below the electric tower. In the semi-circle around the "Fountain of Abundance," a bed of beautiful flowers is to be illuminated so as to bring out all their delightful colors. The lamps for this purpose will be concealed.

Next in importance in electric decorative effect after the incandescent lighting of the main area and buildings must be mentioned the electric fountains. They are placed in an appropriate setting in the middle of North Bay in the southwest corner of the grounds. This body of water is 800 ft. wide by 900 long, and has wooded banks sloping to the shore. A better location from an artistic standpoint could not have been found. The island on which the fountain is located is 160 by 80 ft., and stands 10 ft. above the water level. The main geyser jet is designed to throw a 1½-inch stream 250 ft. high. Around the central jet are 102 fountain orifices and 22 holophote orifices. The 22 searchlights used under the latter were made by Bogue of New York, and are 22-ampere arcs. The pumps for the fountain are electrically operated and located under the fountain deck.

Among other spectacular effects which are being prepared signaling by searchlight from the electric tower to Niagara may be mentioned. The plan will serve as an object lesson to the public of how searchlight signaling is done in the army. A 30-inch 80-ampere projector of General Electric make is being put up for the work at the 360-ft. level of the electric tower, and another will be put at Observation Tower in Niagara Falls. The installation of a searchlight at such a height with clear country around will give unusually good opportunities for studying its effects at a distance. In this connection may be mentioned the lighting of Niagara Falls themselves by searchlights placed on the banks during the Exposition. The preliminary experiments are reported to have been most satisfactory, and visitors to Niagara at night can hereafter enjoy something unknown to former generations. The illumination of the horseshoe fall from Falls View station on the Michigan Central was first successfully accomplished March 22 last.

At present writing it seems likely that Pan-American visitors will have an opportunity to see high-voltage discharge effects put to practical use as spectacular attractions. Paul M. Lincoln, of the Niagara Falls Power Company, and C. E. Skinner, of the Westinghouse Company, have designed apparatus for producing artificial lighting and storm effects in connection with electric signs, which will probably be used somewhere around the Exposition.

Electrical energy for the Pan-American Exposition is derived from three sources. One of them is a sub-station supplied from Niagara Falls, the other two are power plants on the grounds.

The Niagara sub-station, known as power plant No. 1, and so marked on the map accompanying this article, is in the northwest corner of Electricity Building. This is to be used entirely for decorative lighting about the grounds. It has an output of 4500 kilowatts, and contains 18 250-kw General Electric air blast transformers, with a nineteenth in reserve. These receive current from the Niagara Falls high-tension transmission line at 11,000 volts, and

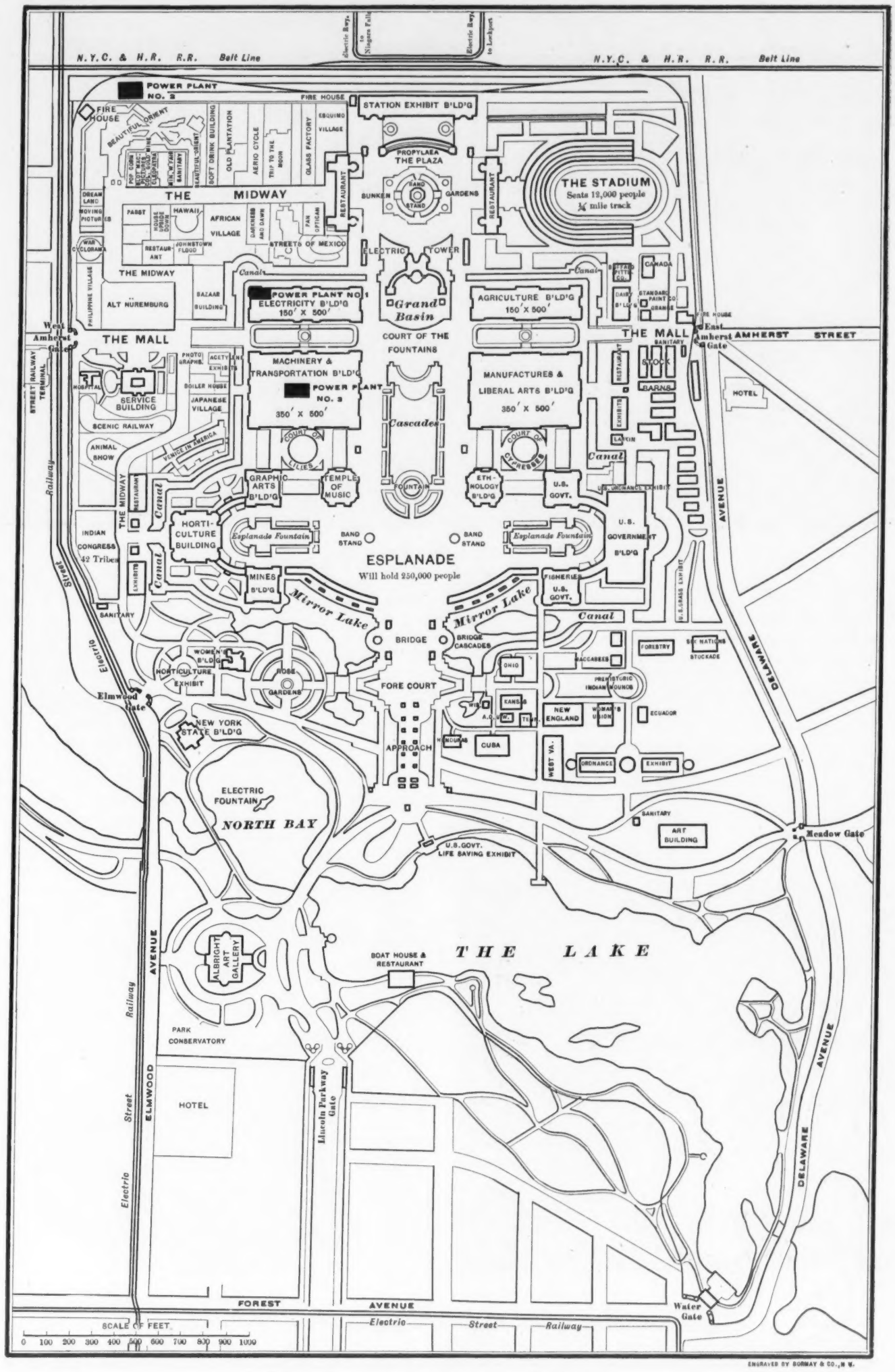


FIG. 2.—PLAN OF THE PAN-AMERICAN EXPOSITION.

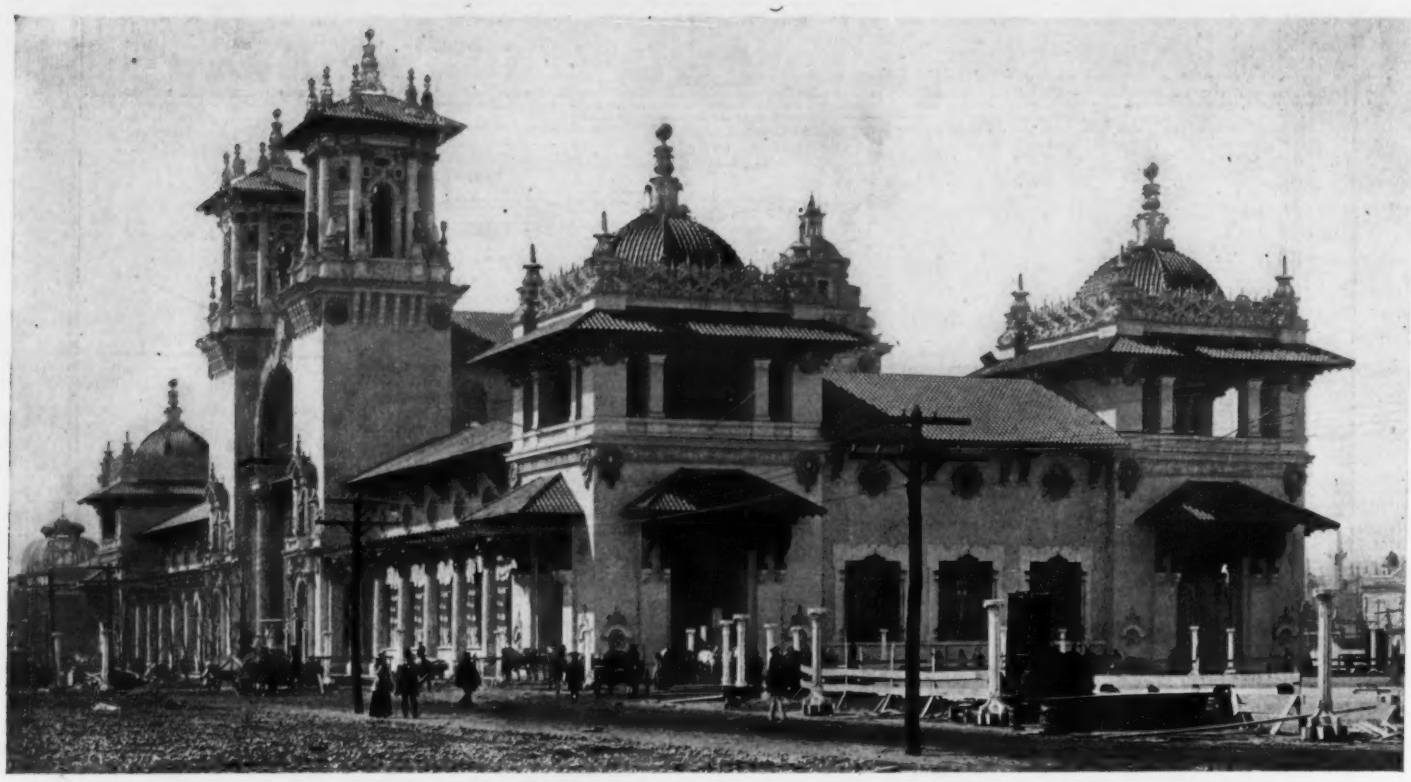


FIG. 3.—ELECTRICITY BUILDING BY DAY.

deliver it to the distributing mains for the grounds at 1800 volts. This is 25-cycle current, but as the decorative lighting which it supplies is all incandescent and there are no arcs on the circuits, it serves the purpose as well as a higher frequency. The magnificence of the decorative lighting can easily be imagined when it is considered what an enormous amount of energy is being spent on it. One feature of considerable interest from an engineering and æsthetic standpoint, is the introduction of a water rheostat into the high-tension mains supplying the sub-station, for the purpose of bringing all the decorative lights on the grounds up to candle-power slowly (in about 80 seconds), and shutting them down equally slowly. This will be working the theater-dimmer idea on the largest scale ever attempted. The water rheostat is mounted in a building on high stilts near the entrance to the grounds and the plates are operated by electric motors so that they can be controlled at a distance. The 19 transformers in the sub-station plant in Electricity Building are shown

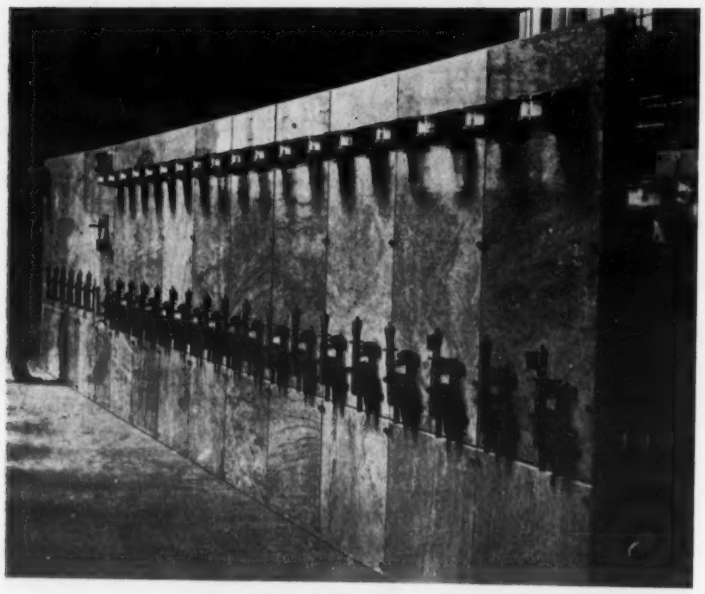


FIG. 5.—SECONDARY SWITCHBOARD IN ELECTRICITY BUILDING SUB-STATION

herewith. They are set directly over a brick vault, which is supplied with air pressure by a Buffalo Forge fan maintaining one-half ounce pressure. The switching apparatus is typical of the best modern practice in the handling of high-tension currents. There is one motor-actuated oil-break switch in the 11,000-volt main circuit and hand-operated oil-break switches in each transformer circuit. The front of the switchboard carrying the oil switches on the transformer secondaries is shown in one of the accompanying photographs.

No. 2 power plant is known as the service plant, and was put in primarily for service rather than for exhibits. It has one Stanley 300-kw, two-phase, 1800-volt, 60-cycle generator driven by a Phœnix Iron Works engine; one Westinghouse 180-kw, two-phase, 60-cycle, 1800-volt generator driven by a Buffalo Forge Company engine; one Stanley frequency changer, changing from 25 to 60 cycles, with 80-kw capacity; one Warren 180-kw, two-phase, 60-cycle, 1800-volt generator driven by an Armington & Sims second-hand engine; four Westinghouse 500-volt, direct-current, 225-kw generators driven by second-hand Armington & Sims engines; two Westinghouse 90-kw, 110-volt, direct-current generators, driven by second-hand Armington & Sims engines; sixteen No. 8 arc machines driven by Armington & Sims engines. It will be seen that considerable 500-volt direct current will be used about he grounds for power purposes.

Power plant No. 3 is in the middle of the Machinery and Transportation Building, and is a combination service and exhibit plant. It contains two units installed by the D'Olier Engineering Company, Philadelphia. They have Erie Ball engines direct connected to Keystone 100-kw dynamos. These supply fountain searchlights and any excess is used for lighting the interior of the court in the Machinery and Transportation Building. A Skinner straight line engine belted

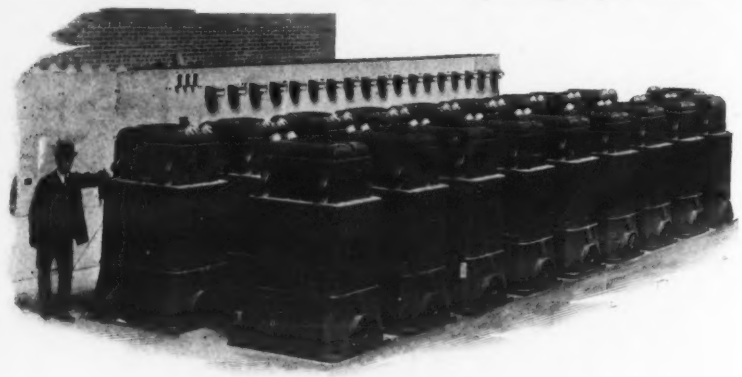


FIG. 6.—SUB-STATION IN ELECTRICITY BUILDING.

to an Onondaga Dynamo Company's 100-kw, 100-volt generator runs motors in the Machinery and Transportation Building. An American Ball engine direct connected to an American Ball 110-volt generator runs arcs in the Horticultural Building. The wires are led

FIG. 4.—EXTERIOR OF ELECTRICITY BUILDING BY NIGHT.

about the grounds in pump-log ducts. Both the lead covered cables and rubber covered wire were furnished by the Safety Insulated Wire & Cable Company.

The lighting of the Electricity Building is to be partly by the Hartford system of G. E. enclosed arcs, with tub transformers, and partly by Nernst lamps, which are to form part of the exhibit of the Westinghouse Electric & Manufacturing Company. The Jandus Electric Company furnishes lamps to light the Graphic Arts, Mines and Horticultural buildings. The three Government buildings are lit by the Miniature Arc Lamp Company's 3.1-ampere lamps.

The electrical exhibits are in charge of Prof. G. F. Sever, superintendent of electrical exhibits, who has worked hard to make the electrical display a representative one. The following is a list of exhibitors up to the time of going to press:

American Electric Telephone Company, American Vitrified Conduit Company, Arnold Electric Power Station Company, Bell Telephone Company, Berliner, E., Bernard E. G. Company, Bettini Phonograph Company, Bossert Elec. Const. Company, Buckeye Electrical Company, Bullock Electric Company, Camp, H. B., Company, Clark Automatic Tele. Company, Crocker-Wheeler Company, Cutler-Hammer Manufacturing Company, Delany, P. B. D'Olier Engineering Company, Edison Manufacturing Company, Elec. Storage Battery Company, General Electric Company, Gould Storage Battery Company, Hanfield, B. & E., Hazard Manufacturing Company, Holland, C. E., Holophane Glass Company, Inc. Elec. Lt. Man. Company, Jandus Electric Company, Johnson, Eldridge R., Keystone Electric Company, Lea Manufacturing Company, Lubin. A., McClure, S. S., & Co., McRoy, John T., Mann Brothers, Marland, W. J., Mason Monogram Company, Morris Electric Company, National Auto. Tele. Company, National Carbon Company, National Gramophone Company, Northern Elec. Manufacturing Company, Onondaga Dynamo Company, Perkins, F. C., Peru Electric & Manufacturing Company, Rowell, C. B., Safety Ins. Wire Company, Shelby Electric Company, Standard Underground Cable Company, Stanley Elec. Manufacturing Company, Stanley Instrument Company, Stromberg-Carlson Tel. Manufacturing Company, Submerged Elec. Motor Company, Syracuse Elec. Inst. Company, Toerring, C. J., Co., Wagner, R. V., & Co., Waite & Bartlett Manufacturing Company, Warren Elec. Company, Western Electric Company, Westinghouse Elec. & Manufacturing Company, White, The O. C., Company, Wilhelm Telephone Company, McGraw Publishing Company.

In the west end of the Electricity Building is a collective historical exhibit which will offer a good opportunity to those not familiar with the beginnings of the art, to become informed. This will include some of the pioneer work of the Edison and Thomson-Houston companies. Besides the 60 or more regular individual exhibitors having space in the Electricity Building, a collective exhibit for small companies under charge of W. J. Marland, 132 Nassau Street, New York, includes a number of concerns whose goods were not of sufficient bulk, number or importance to justify taking individual space.

The two largest exhibits are those of the General Electric and Westinghouse companies. The sub-station in the building, although

FIG. 7.—EAST WING OF THE LOGGIA OF ELECTRIC TOWER.

not a part of the General Electric Company's exhibit, adjoins that company's regular space and is composed entirely of its apparatus so that it practically forms part of the General Electric display. The Nernst lamp makes it first public appearance, on a large scale,

in America in the lighting of the central part of Electricity Building as a part of the Westinghouse exhibit, and forms one of the most interesting technical electrical exhibits on the grounds.

As in all other exhibits at the Pan-American Exposition, quality instead of quantity has been sought for. Apparatus showing the most advanced state of the art or illustrating its growth was sought rather than large quantities of material of no special interest. The telephone exhibits are especially fine, and show well what an awakening there has been in that branch of electrical work the past few years. A commendable piece of enterprise is that of the Stromberg-Carlson Telephone Manufacturing Company, of Chicago, which, in connection with its exhibit in Electricity Building, has put in an exchange for the use of the various operating departments of the Exposition free of all charges. This service was inaugurated over two weeks before the opening, and was greatly appreciated by the management and staff. The system is the company's regular central energy, and the switchboard is located in the exhibit space as a part of the exhibit. Paul M. Krahmer is in charge of the installation.

LUTHER STIERINGER, CONSULTING ELECTRICAL ENGINEER.

PROFESSOR GEORGE FRANCIS SEVER, SUPERINTENDENT ELECTRICAL EXHIBITS.

HENRY RUSTIN, CHIEF OF ELECTRICAL AND MECHANICAL BUREAU.

In connection with the foregoing article, and the lists of exhibtors, we are enabled through the courtesy of some of the exhibitors to give in advance a brief note of the nature of their displays, or of the apparatus furnished by them of an exhibit character:

The Jandus Electric Company.—The Horticultural, Mines and Forestry buildings of the Pan-American Exposition will be lighted with Jandus standard enclosed arc lamps. The Jandus Electric Company, in conjunction with the Buckeye Electric Company, will make an elaborate exhibit in the Electricity Building. The exhibits will be in charge of a corps of representatives from Cleveland, assisted by Mr. H. I. Sackett, of Buffalo, Mr. T. H. Bailey Whipple, general sales agent, will spend as much time at their exhibits as his duties will permit.

Frank C. Perkins, manufacturers' representative, Buffalo, N. Y., will have an exhibit in Section "M," Electricity Building, of a full line of cut-outs, non-arcing fuses and junction boxes of the D. & W. Fuse Company, of Providence, R. I., also a number of the finest designs of electric table lamps manufactured by the American Brass & Lamp Company, of Trenton, N. J. A number of electric focusing hand-feed lamps, chasers and electric stereopticons will be shown.

The Holophane Glass Company, New York, will have a very complete display of holophane glass fitted to electric incandescent and arc lights, also incandescent gas, acetylene and Pintsch lights. One-half of the company's space will be given over to a dark-room laboratory, in which two special photometers will be erected for testing the candle-powers of various light when used with different styles of glass globes. One of the photometers is of the company's invention, and enables any one to judge at a glance of the illuminating powers of light, without the use of any optical instrument. The laboratory will be available to any one who may wish to test for themselves their own lights or those of others.

The D'Olier Engineering Company, Philadelphia, Pa., will be represented by an isolated electric plant consisting of a self-oiling automatic high-speed Ball engine direct connected to a 110-kw generator, also an additional unit consisting of a Skinner engine belted to a 120-kw generator, together with a special switchboard of the company's own manufacture. The plant will be in the Power Court of the Machinery and Transportation Building, and will be used in the operation of the electric fountain and for supplying a number of arc lamps in the building with current. The exhibit will illustrate a modern plant of small size, both belted and direct connected.

The National Automatic Telephone Company, of Chicago, will have a complete display of its telephones and switchboards. The exhibit will also include interior plants, small exchanges with a capacity to 100, and larger exchanges with a capacity above 100 to 1000 or more. The new party line telephone will also be exhibited. This instrument can be entirely controlled from the central office, and can

Fig. 8.—Machinery and Transportation Building by Night.

be run in connection with a manual or automatic exchange. As many telephones as desired can be connected to a metallic line and no subscriber can converse until "central" is first called up.

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR COMPANY.—A corps of men will be employed throughout the different buildings of the Exposition for the purpose of cleaning and replacing the thousands of incandescent lamps which will be used during the Exposition, by means of the incandescent electric lamp replacers and cleaners manufactured by the company above named. These appliances have already been described in these columns. They are so constructed that they will unscrew or screw into place any shape or size of incandescent lamp at any height or angle. They are made of aluminum, and are consequently light in weight, and their use does away with the necessity and inconvenience of ladders, staging, etc. All of these appliances together with many others manufactured by the company, will be seen in operation at Section "M," Electricity Building. Mr. George Lighthart, the company's selling agent, will look after its interests at the Exposition and will give information on the subject of its devices.

THE EUREKA TEMPERED COPPER WORKS, North East, Pa., will have an interesting and unique exhibit in Section "Q," in Electricity Building. It will be designed entirely to show the production of copper for electrical and mechanical purposes. The exhibit will also include a complete line of Eureka rail bonds, commutator segments, trolley wheels, etc.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, will have a very complete exhibit of carbons in almost all forms for every imaginable use. Among the most important articles contained in the display will be the following: Cored and solid carbons for enclosed and open arcs, searchlights, headlights, focusing lamps and other electrical appliances; smelting carbons for smelting gold, silver, copper, aluminum, alloys and other metals; carbon electrodes for use in connection with large electrical furnaces, such as are used in the manufacture of carbide; carbon electrodes for chemical purposes used in connection with electric currents for the separation and purification of various liquid elements, and carbon brushes in all sizes, both flat and round, for fan and other stationary motors of all kinds, street railway motors, dynamos and generators of all sizes. In addition to the above, there will be a variety of carbon cups, carbon cylinders, tubes, plates of all dimensions, carbon buttons, carbon disks or diaphragms used in connection with telephones, transmitter carbons or back plates as they are sometimes known, granular carbon, globular carbon, also used in connection with telephones for transmitter carbon; carbons for lightning arresters, carbon pencils and boxes, and many other specialties.

THE SPRAGUE ELECTRIC COMPANY.—Printers, electrotypers and others who visit the Exposition can see the practical operation of Lundell motors in connection with printing presses and other machines used in the allied trades. Among other exhibits will be one of the John Thomson Press Company, whose job presses will be operated by a Lundell 10-hp round-type motor; R. Hoe & Co. will operate all their electroyping machines by the Lundell motors, and the Dexter Folder Company will have several of its machines and also a Scott printing press operated by a Lundell motor.

THE GENERAL ELECTRIC COMPANY.—The space occupied by this company is in the northwest corner of the Electricity Building, adjacent to the 500-hp Exposition transformer plant, which is also an exhibit of this company. The company's reception quarters are in an handsome booth on the western end of the space. This comprises a conveniently arranged office, from which one may ascend to a comfortably furnished balcony overlooking the entire building. Between the transformer plant and the north side of the building is a well-lighted gallery of photographs. An excellent idea of the extent of the company's business in all branches can be obtained from this part of the exhibit. Passing out into the space, one finds apparatus of the latest type for generating, transforming and regulating electric current and electric lamps and motors of every type for its practical utilization. One of the exhibits in the Electricity Building is the model of the General Electric Company's works. This model is located at the eastern entrance to the exhibit on the main aisle of the building. This covers a floor space of about 12 by 24 ft., and represents accurately at a scale of 1 inch to 20 ft., the large manufacturing plants of this company at Schenectady, Lynn and Harrison. The lighting of this model is so arranged that day and night effects are produced alternatively. The night effect is accomplished by lights arranged under the model, which show through all of the windows of the buildings, presenting the appearance of the factories running in full operation at night. This company furnishes a great deal of electrical apparatus and supplies for use about the grounds by the Exposition Company and by exhibitors and midway concessionaires. About 300,000 incandescent lamps have been furnished by the company, beside many type "H" oil transformers. Electric motors of the General Electric make are found in exhibits in almost every building. An interesting example is found in the Government ordnance group, where the large gun mounted on a disappearing carriage is

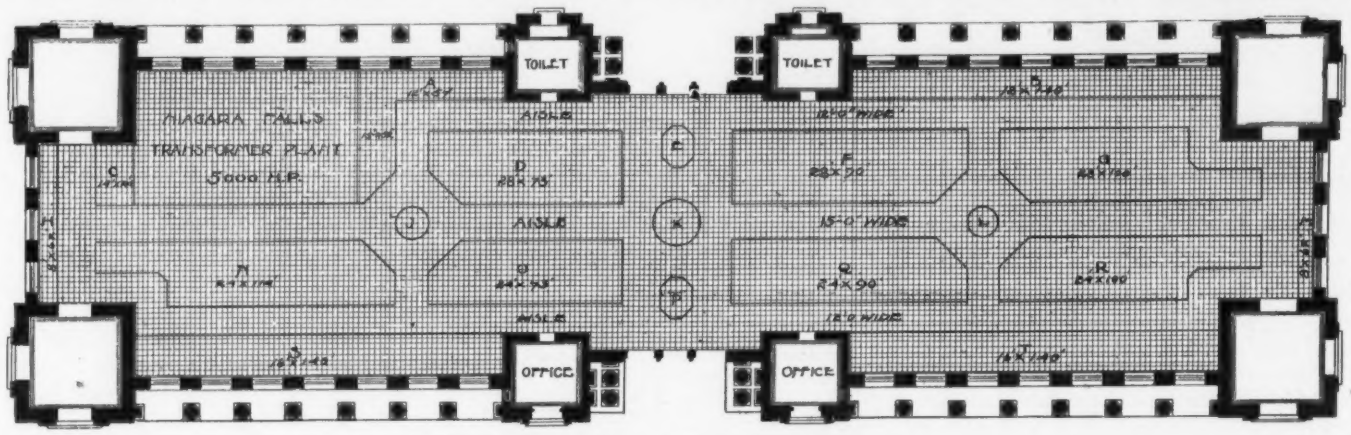


FIG. 9.—FLOOR PLAN OF ELECTRICITY BUILDING.

entirely operated by G. E. motors. The large searchlight located in the top of the Electric Tower is an exhibit of the General Electric Company. A similar one also furnished by this company is located at Niagara Falls, and it is expected signals will be exchanged between these searchlights, and that the one on the Electric Tower will flash signals nightly about the surrounding country.

THE FERRACUTE MACHINE COMPANY, of Bridgeton, N. J., will exhibit 12 of its presses, the heaviest being a large double-crank press, with friction clutch, for grinding armature disks, arranged to be driven by an individual motor, and it will weigh about 7 tons. It will have 8 power presses of various sizes and kinds, adapted for cutting, punching, forming and various other work. Among these is a notching machine for armature disks, which will be shown in working condition. Its total space is about 30 by 22 ft., fronting on three aisles. The whole outfit will be driven by electric motors.

THE SUBMERGED ELECTRIC MOTOR COMPANY, Menomonie, Wis., will have an exhibit in Section "S," Electricity Building, of its submerged motor for small boats run by two or more batteries. The outfit is portable and will be used on the lagoon, where it will be seen in operation during the exhibition.

MR. ALBERT MANN, Buffalo, N. Y., will have a collective exhibit, representing the Chase-Shawmut Company, for outlet boxes and nipples, the Richmondt Electric Wire Conduit Company for electro-galvanized conduit, and Mann Brothers, of Chicago, for washing machines and wooden ware, made with electrically welded wire hoops. The booth will be built of the Richmondt conduit and Chase-Shawmut boxes. The space is located in Section "S" in the Electricity Building.

THE MORRIS ELECTRIC COMPANY, New York, will have an exhibit

in Section "B," Electricity Building, boards mounted with rail bonds, "Monarch" fare registers, hydraulic solderless splices and terminals, Anderson overhead line material, Keystone instruments, Garton lightning arresters and Anderson vehicle instruments. Besides these the company will show a large number of Keystone instruments, a hydraulic splicing machine, a hydraulic rail punching machine, some Potomac terra cotta conduit, "Wood" car gates, iron poles, brackets and various fittings for railway and lighting apparatus and a miscellaneous lot of supplies, such as street railways are continually using. The several members of this company will be present.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY, Providence, R. I., will occupy a space in the extreme east end of the Electricity Building, in Section "G." Its exhibit will consist of boards manufactured especially for exhibition purposes, wired to their full capacity, 12, 24, 48 and 72. The 24-point board will be used to demonstrate the principle of the apparatus, wiring to several different types of telephones which the company will have on the premises and showing the application of the system to magneto and push-button call instruments.

THE ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., will exhibit a 75-kw, 110-volt, direct-current dynamo, direct connected to a 15 by 13 straight line engine. This machine will be placed in the court of the Machinery and Transportation Building. It will be under the control of the Exhibition people, and is for lighting that building. In addition to this, and in the Electricity Building, in Section "N," the company will have a space 10 by 24 extending across that section, in which it will exhibit a line of enclosed motors, a multipolar "Clover Leaf" type, 12-kw and one 40-kw 6-pole ring type, both belt driven. The company also expects to display a switchboard with S. E. I. Company instruments upon it.

THE AMERICAN VITRIFIED CONDUIT COMPANY, New York, is preparing an elaborate display of its products in vitrified clay underground conduits. This will include multiple ducts in forms from two up to 16, also self-centering conduit, single and single conduit with plain ends.

THE STANDARD UNDERGROUND CABLE COMPANY'S EXHIBIT occupies the extreme western end of Section "F," immediately on the aisle. It is composed of four cases containing a display of samples of all of the various styles of rubber insulated, paper insulated covered cables and rubber insulated wires which are manufactured by this company. One case is devoted exclusively to the wires and cables, terminal heads and accessories as used in street railway work, including an assortment of the patented junction boxes as used and perfected by this company. Another case contains the telephone wires and cables manufactured by this company, also the company's patented terminals and lightning arresters. In the third case are shown cable wires and accessories used in electric light and power works, as distinct from street railway work, and the fourth case contains the cables, terminals, lightning arresters and accessories as used in telegraphic work and particularly in municipal work for fire alarm systems.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, of Utica, N. Y., is located in Section "B," Electricity Building, between the exhibits of the H. B. Camp Company and the National Carbon Company. The exhibit consists of a display board wired as a switchboard with four panels, surmounted by an oak cornice and name board. The two center panels are white marble on which are mounted the company's regular type adjustable contact knife switches for switchboard work and also some samples of new "Imperial" switches which the company is just about to place on the market. Two samples of quick break switches embodying some new features, are shown. On the two outside panels there are mounted different types of steel-drawn wall boxes and steel junction boxes of various types and also samples of Erickson conduit insulators. The whole board is lighted by four two-light brackets, one at the top of each panel.

VICTOR TALKING MACHINE.—Mr. Eldridge R. Johnson, of Philadelphia, Pa., will make an exhibit of the Victor talking machine.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has two exhibits, one in Section "B," of the Electricity Building, and the other in Machinery Building. The former exhibit includes five motors, one of 2 horse-power, two of 10 horse-power, one of 12 horse-power and one of 30 horse-power, three induction motors and four generators, varying in capacity from 25 kilowatts to 150 kilowatts. On the other side of the space are shown five alternating-current Wagner motors of the Wagner Electric Company, St. Louis, ranging from one-fourth to 15 horse-power, also six Wagner generators ranging in capacity from 1½ kilowatts to 25 kilowatts. There is also one Wagner oil and water cooled transformer of 175-kw capacity, and one 100-kw air-blast transformer. Between the two sections of this exhibit are two switchboards, one controlling each section, and at the back of the exhibit is an electric sign whereon is the company's name. The Machinery Building exhibit includes one 6-hp, 220-volt, 400 r. p. m. motor, driving a planer in the exhibit of the American Tool Company, and one 6-hp, 110-volt, 400 r. p. m. motor in the exhibit of the Belmer Eames Tool Company. The Belmer Eames Company is also furnished a motor generator set for lighting the Government Building at the Exposition. This set will consist of one 65-hp type H, 500-volt motor mounted upon a solid iron base with a 42½-kw type H generator.

THE EDISON MANUFACTURING COMPANY will make a general exhibit which will include phonographs as well as its particular line of goods all the way through. Later on it expects to exhibit Mr. Edison's new storage battery, possibly the thermopile that may come out later.

THE C. J. TOERRING COMPANY, of Philadelphia, will show 50 lamps equipped with Holophane globes, which will light the court of the Manufacturers' Building. The company's individual exhibit will probably be associated with that of the D'Olier Engineering Company.

ELECTRIC VEHICLES will be very much in evidence in the Transportation Building, where there will be fine exhibits of automobiles of all types by the Electric Vehicle Company, American Electric Vehicle Company, Buffalo Electric Vehicle Company, Woods Motor Vehicle Company and the De Dion-Bouton Motorette Company. The Electric Vehicle Company will have a particularly handsome space.

THE E. G. BERNARD COMPANY, Troy, N. Y., will furnish a 125 hp 500-volt to 110-volt motor generator for the purpose of furnishing power for the electric fountain. This fountain will have 21 projections and will be the largest fountain of the kind ever built. The Exposition Company is putting up a special building for the Bernard Company's use near the New York City Building, which will contain its exhibit.

THE WAITE & BARTLETT MANUFACTURING COMPANY, of New York, will make a display of electro-medical and electro-surgical instruments and static machines. The exhibit will be located in Section "M," of Electricity Building, and the company intends to make a fine and practical working exhibit.

THE EUREKA ELECTRIC COMPANY, INC., of Chicago, Ill., has Messrs. G. B. Pratt and I. C. Woodford, of Buffalo, N. Y., as Eastern representatives. They will make no exhibit at the Exposition grounds, but will use for this purpose two of their large rooms in the Ellicott Building. The firm will have samples of all Eureka apparatus installed in the offices and in practical operation.

THE STANLEY ELECTRIC COMPANY and the STANLEY INSTRUMENT COMPANY, of Pittsfield, Mass., and the NORTHERN ELECTRICAL MANUFACTURING COMPANY, of Madison, Wis., will have a joint exhibit in Electricity Building. The Northern Company will make a display of its apparatus, including one 3-hp motor direct connected to a Wood's propeller pump, one 7½-hp motor geared to start a synchronous motor, one 40-kw generator direct connected to a synchronous motor, one 10-hp motor operating a Stanley frequency changer, and various other motors, some of which will be direct-connected to machines of different kinds. The company will also have one motor generator set to operate the exhibit, a 75-kw engine type generator, and a switchboard. The company will have motors in the exhibits of different machine companies, used in driving machinery of other concerns.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., will occupy a floor space of 20 by 24 ft. in Section [illegible] Electricity Building. The space will be devoted to the exhibition of smaller machines of standard types of this company's manufacture, and no attempt will be made to illustrate special applications. The exhibit includes 3 3-hp, 7 7½-hp and 25 25-hp 4-pole motors of the semi-enclosed and completely enclosed types. There will also be shown a 5-hp, size 5 F motor and a size 7½ F motor dynamo consisting of two standard motors direct connected. To illustrate the large size of open type machines there will be a 10-hp and a 20-hp motor, and as an example of the Crocker-Wheeler Company's direct-connected engine type dynamo, there will be exhibited a size 34 D 30-kw 300 r. p. m. machine, mounted on a temporary foundation. This dynamo has an 8-pole magnet, with the Crocker internal flange magnet ring. There will also be exhibited a size 2½ enclosed type heavy torque motor suitable for crane service. This machine is of normal 2½

horse-power, but capable of working up to a much higher torque, and is commonly used for the trolley travel on smaller sized cranes. The Crocker-Wheeler magnetic brake mounted on a 5-hp motor will also be exhibited. The exhibit will also contain several styles of drum controllers, a knife-blade type of starter suitable for very large motors with automatic devices, and a ½-hp, 2-pole motor illustrating the smallest sizes of this form of machine manufactured by this company. The exhibit will be identified by a handsome metal sign bearing the name of the company in about 350 incandescent lamps.

ONE TELEPHONE EXHIBIT at the Exposition will consist of a complete central office equipment of the latest design and in full operation. The switchboard and other equipment will be furnished by the Western Electric Company, and is to be patterned after the recent installations by the Bell companies in Boston, New York, Buffalo and elsewhere. It is to be of the common battery multiple type with lamp signals throughout. The switchboard will be equipped for about 600 lines, and will have positions for nine operators. In two of these positions will be placed the incoming trunk lines of the several exchanges of the Bell Telephone Company, of Buffalo. This office will be operated by the Bell Telephone Company of Buffalo, and will, in fact, constitute during the Exposition, one of the central offices of its Buffalo exchange system. The switchboard will be connected to lines extending to telephone stations located at all parts of the Exposition grounds. The wires have been placed underground. One of the features in connection with the telephone exhibit will be the Roar of Niagara, which was such a great attraction at the exhibition in connection with the convention of the National Electric Light Association in New York City a few years ago. It is interesting to note in this connection also that long-distance talking from the Exposition grounds will be effected by means of power developed by Niagara Falls.

MR. W. JAC MARLAND, of New York City, as the curator of a collective electrical exhibit in Electricity Building, will represent the following concerns: Charles J. Bogue, New York; Edison-Johnson Electrical Manufacturing Company, New York; Dunn-Martin Electric Company, New York; Thomson Electric Welding Company, Lynn, Mass.; H. C. Cushing, Jr., New York; Prentiss Clock Improvement Company, New York; Power Installation Company, F. B. Sage & Brother, New York; The Diamond Arc Lamp Company, Harold P. Brown, New York; Emile J. Fardie, H. P. Cameron Electric Manufacturing Company, Syracuse, N. Y.; William Roche, New York; Smith & Hemenway, New York; Parsell & Weed, New York; Standard Welding Company, Cleveland, Ohio; Electric Contract Company, New York; Queen & Co., Philadelphia; Socket Extension Tap Company, Boston, Mass.

THE BETTINI PHONOGRAPH LABORATORY, of New York, will have an exhibit of recording and reproducing machines in Section "T." of the Electricity Building, which will demonstrate the latest development in the recording and reproducing of sound. The Bettini booth will contain a fine exhibition of much that is new and worthy of public notice in the line of talking machines and attachments, as well as the full line of the Bettini products.

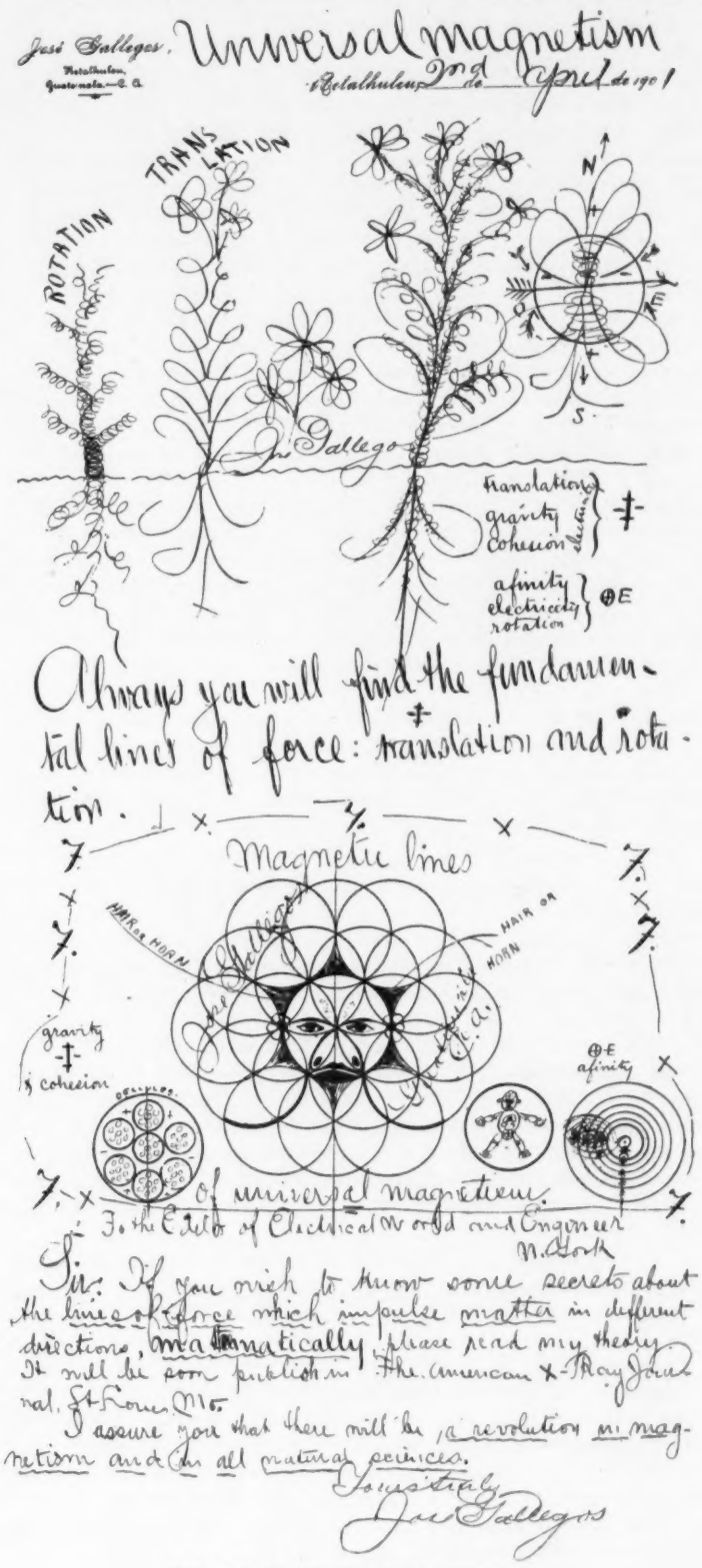
Moving the Stock Exchange Telephones.

A smart piece of work was done last week by the construction and maintenance departments of the New York Telephone Company in the removal of the 400-odd private line telephones used by the members of the Stock Exchange from the old Exchange to the temporary quarters secured at the Produce Exchange. Some weeks before the date of the removal the construction department ran a special 400-pair underground cable from the Stock Exchange to the Produce Exchange, by which to extend the brokers' private lines from the old terminal to the new. At the Stock Exchange the wires of this cable were bridged onto the working lines in proper order and at the Produce Exchange end they were distributed by 25-pair house cables to the positions to be occupied by the telephones. On Friday at 3.30 p. m. the maintenance force of 20 men began the work of dismantling the telephones at the Stock Exchange, and by midnight 430 telephones were in position at the Produce Exchange, connected up and ready for working. Fresh batteries had been placed in position beforehand, so that the work of removal was reduced to its simplest terms. As far as the telephone company was concerned the brokers might have gone right to work in their new quarters on Saturday morning. The removal of 411 telephones (19 of the 430 were new stations), and their connection ready for working at a new terminal within 8½ hours of starting the work is a pretty quick job. The work would actually have been done in less time, however, but for the fact that the backboard of every instrument had to be sawn off to fit under a ledge on the wall or partition of the Produce Exchange.

On testing out the lines the next day, when the brokers' offices were opened for the purpose of assuring communications with the new battlefield, there was found to be no defect in the new line, barring three minor instrument troubles. This well-planned and smartly executed removal speaks well for the efficiency of the construction and maintenance departments of the New York Telephone Company.

A Promised New Theory of Magnetism.

The following reproduction of a letter received is printed as an example of the freak communications which from time to time come to the editor's desk and offer new theories of electricity or magnetism.


Universal magnetism
ROTATION
TRANS LATION
N
S
E
W
Always you will find the fundamental lines of force: translation and rotation.
Magnetic lines
HAIR OR HORN
gravity
cohesion
ΦE
affinity
of universal magnetism.
To the Editor of Electrical World and Engineer
N. York
Sir: If you wish to know some secrets about the lines of force which impulse matter in different directions, mathematically please read my theory. It will be soon publish in the American X-Ray Journal, St Louis Mo.
I assure you that there will be a revolution in magnetism and in all natural sciences.
Sincerely
Jose Gallegos

THE LATEST THEORY OF MAGNETISM.

Electrolytic Treatment of Sulphide Ores.

The so-called "complex sulphide ores," and particularly those of the Broken Hill district, have long proved a stumbling block to metallurgists. These ores consist substantially of a mixture of zinc and lead sulphides with considerable silver, are difficult to roast by reason of the high percentage of lead, and have proven exceedingly refractory to after-treatment. The problem has been an attractive one for electrometallurgists, and we find associated with it the names of Watt, Diffenbach, Mohr, Hoepfner, Siemens and Halske, Ashcroft, Swinburne, Canelin, Lorenz, Ketchum and others. That their labor has availed little may be concluded from a recent statement that at present there are recovered from these ores but one-half of the lead, one-third of the silver, and no serviceable portion of the zinc. It is of interest, therefore, that a patent has just been issued (April 23) to Mr. Sherard Osborn Cowper-Coles for the following electrolytic treatment of the Broken Hill ores.

The ores are crushed, mixed with one-fourth to one-half their weight of zinc or copper sulphide, and subjected to a dead roast, the zinc blend serving to keep the mass open and porous during the operation. After screening and removal of dust, the ores are subjected to three distinct leaching operations. First, with dilute sulphuric acid to extract zinc and copper, then with a strong solution of caustic soda to dissolve the lead, and finally with cyanides whereby the precious metals are recovered. During the leaching with acid the ores rest upon an insoluble anode, and an electric current is passed through the bath to a superposed zinc cathode, contained in a porous protector. The solution, now nearly or quite exhausted of free acid, passes through a filter of mixed carbon and iron, or carbon and zinc, fragments, to precipitate any copper, and is thereafter electrolyzed to deposit zinc, employing a lead anode, and as cathode a cast iron cylinder which revolves slowly in the bath. The zinc may be recovered in compact form or as zinc sponge, according to the chemical and electrical conditions.

The alkaline solution containing the lead may be electrolyzed for recovery of the metal, or may be utilized for the production of white lead and sodium carbonate by the direct injection of carbonic acid gas as in the Meyrueis process. The cyanide solution containing the silver is electrolyzed or otherwise treated to recover this metal and any gold which may be present. The fine dust from the crushing is subjected to a separate treatment similar in all respects to the foregoing.

Mr. Cowper-Coles' success heretofore in the electrolytic treatment of zinc solutions and the fact as stated by him before the Society of Engineers that the process has been in successful experimental operation, encourage the hope that the procedure may afford a commercial solution of an extremely difficult problem.

Donations to the Institute Library.

The current issue of the *Transactions* of the American Institute of Electrical Engineers announces donations to the Institute Library aggregating almost 350 volumes. The most important of these are complete sets of the *Comtes Rendus* and the *Proceedings* of the Royal Society. For the purchase and binding of the former, numbering 125 volumes, it is announced that Mr. C. O. Mailloux donated $275. We learn, however, that the set will actually number more than 130 volumes, and that to defray the cost of a better binding than originally provided for, Mr. Mailloux has considerably increased the amount of the donation as printed. The set of the Royal Society *Proceedings* (41 vols.) was donated by Mr. Edward Caldwell.

The other donors on the list are the *Electrical Review, Electrical World and Engineer,* T. C. Martin, W. D. Weaver and Townsend Wolcott. Among the gifts are a number of sets of periodicals, some of which, from the rarity of the earlier volumes, are of great value. Following is a partial list of these:

Electrical Engineering, 1893-1898, Vols. 1-11; *Electricity,* 1891-1899, Vols. 1-17; *Journal of the Telegraph,* 1867-1881, Vols. 1-16; *The Telegrapher,* 1864-1876, Vols. 1-12; *La Lumière Electrique,* 1879-1884, Vols. 1-14; *Scientific American,* 1859-1886, Vols. 1-55 (Vol. 10, 1864, lacking); *Scientific American Supplement,* 1876-1886, Vols. 1-22 (Vol. 13, 1882, lacking); *Street Railway Gazette,* 1886-1893, Vols. 1-9; *Science,* 1880-1894, Vols. 1-8.

Among the books are two useful works of reference, Du Moncel's "Exposé des Principales Applications de l'Electricité (5 vols.), a valuable account of the art covering the epriod to 1873; and Dredge's "Electric Illumination" (2 vols.). The following works of historical value are also numbered among the gifts:

"Evidence in the Bain Suit." U. S. Circuit Court, Eastern District, Pennsylvania. B. B. French et al. *vs.* H. J. Rogers et al. Philadelphia, 1851. This was the personal copy of Professor S. F. B. Morse, and is copiously annotated in his own handwriting.

Nollet L'Abbe. "Recherches sur les Causes Particulières des Phenomènes Electriques." Paris, 1749. In this work the author lays down an electrical theory, according to which the cause of electrical phenomena is the "effluence and affluence" of a subtle fluid everywhere present. When a body is electrically excited it emits fluid of one sign and attracts fluids of another sign. Some interesting experiments with vacuum tubes are described.

"Rapport fait à la Classe des Sciences Mathematique et Physique de la Institut National sur les Experiences du Citoyen Volta." Lu le 11 frimaire, an 10 (Dec. 2, 1801). This is the original report, printed for the Institute, of a committee before whom Volta appeared, consisting of Laplace, Coulomb, Charles Biot, Monge, Foucroy, Vauquelin, Pellatan, Brisson, Guyton and Sabathier. In an appendix the phenomena of the Volta pile are made the subject of mathematical analysis.

New York Automobile Legislation.

Governor Odell, of New York, has signed the bill of Mr. Doughty, providing for registration of automobiles with the Secretary of State and allowing them to run on any highway in the State at a speed not to exceed 15 miles an hour, outside of incorporated cities and villages. The Doughty bill was drawn up by the Law Committee of the Automobile Club of America. The main idea was to secure for motor vehicles a uniform rate of speed throughout the entire State, as it was found that many towns and counties differed materially in their automobile regulations, some going so far as to fall back upon an old law regarding steam engines upon the highway, requiring a person to precede the machine and give warning. The automobilists found that in many instances they were not accorded equal rights with the drivers of horses, and the confusion resulting from these various laws led to the need of a uniform standard.

The Doughty bill regulates the speed of automobiles in cities and villages to 8 miles an hour and in open districts to 15 miles an hour. Municipalities cannot impose a less speed than 8 miles an hour, but they may permit a greater speed, if deemed advisable.

The original draft of the bill was amended in the Senate, securing to the Park Commissioners of New York City their jurisdiction over the speed and admittance of motor carriages in the parks or upon any streets controlled by the Park Department.

The Cable Service to Brazil.

Mr. Eugene Seeger, United States Consul-General at Rio Janeiro, Brazil, makes an interesting report on cable service with our sister Republic: Improvements of an important character, materially affecting the facility and cost of cable communication between Brazil and the United States, have been made by the Western Brazilian Cable Company. As a result of the new line opened by the Commercial Cable Company from New York to the Azores Islands, connecting with the line from Brazil via Lisbon, messages can now be sent without the delays incident to the crush of business in the London offices, which formerly had to handle all the Brazil communications. The managers of the large coffee houses in Rio, who use the service constantly in their business, say that the new lines have proved very beneficial. In addition to the increased facilities, an advantage has been gained in the cost of transmission. The rates have been reduced on an average 25 per cent. Formerly, the charge per word from Rio de Janeiro to New York was nearly $1.30; now it is about $1. The average time for a word in transmission between the two places is from 18 to 25 minutes. Messages have come through in 12 minutes. The company sends all messages by Lisbon and the Commercial Cable Company's line, unless another route is specified by the sender.

The consolidated company operating at Rio de Janeiro under the name of the "Western Cable Company" is a union of the Western Brazilian and the Brazilian Submarine. It has three cables from Pernambuco to Rio de Janeiro, two from Pernambuco to Para, two

from Pernambuco to London, and one from Pernambuco to Lisbon.

The following rates may be of interest:

	Milreis.	
Canada, New York City, Boston, Baltimore, Philadelphia, Washington, Chicago, and New Orleans...	4.68	= $1.00
Barbados	8.91	= 1.91
St. Thomas	9.18	= 1.96
Habana	5.45	= 1.16
Trinidad	9.27	= 1.98

Connections are made with all the important ports from Para to Montevideo. The charges per word are based on the average rate of exchange for every three months, as determined by the Brazilian Government. At present it is 900 reis to the franc (19.3 cents), and if exchange remains above 11d., it will soon be considerably less.

Submarine Torpedo Fighting.

In his recent lecture on submarine boats, noted last week, Mr. Holland discussed various features, such as the use of such boats for passenger travel. As to submarine fighting he said: "When the first submarine torpedo boat goes into action she will bring us face to face with the most puzzling problem ever met in warfare. She will present the spectacle, when used in attack, of a weapon against which there is no defense. You can send nothing against the submarine boat, not even itself. You cannot fight submarines with submarines. The fanciful descriptions of the submarine battles of the future have one defect. You cannot see under water. Hence you cannot fight under water. Wharves, shipping at anchor, the buildings in seaport towns, cannot run away. The sending of a submarine against them means their inevitable destruction. To-morrow, if we had a fleet of submarines big enough, they could protect New York Harbor against an attack by the combined fleets of the world. But our shipping and our city would still be at the mercy of the enemy, if they had only one submarine, manned by a fearless crew of experts. You could not mine against her, for she would countermine. You could not close the harbor against her, even with a network of torpedoes and chains stretched across the Narrows, reaching from the surface to the bottom of the channel. From a safe distance she could send a torpedo against the network that would blow it to pieces, giving her all the passageway she wanted to go in and out. You could not chase her with a fleet of your own submarines, because you could not find her under water. How the menace of the submarine is to be met nobody has at this time been able to say. The genius of scores of inventors is grappling with the problem, but so far without result. All are agreed, however, that in one direction at least she will forever remain unconquerable. She will make a close blockade impossible."

The Long-Distance Automobile Endurance Test.

The automobile test of 500 miles from New York City to Buffalo, under direction of the Automobile Club of America, will be held during the week beginning Monday, Sept. 7. The Automobile Club committee has now announced the date and details of the trial. The regulations include tests for five classes of vehicles. The classes are:

Under 1000-Pound Class—Four-wheeled motor vehicles weighing under 1000 lbs., in commercial running and operating condition, with tools, fuel and supplies on board.

1000 to 2000-Pound Class—Four-wheeled motor vehicles weighing between 1000 and less than 2000 lbs., in commercial running and operating conditions, with tools, fuel and supplies on board.

2000-Pound or Over Class—Four-wheeled motor vehicles weighing 2000 lbs. or over, in commercial running and operating condition, with all tools, fuel and supplies on board.

Motor Cycle Class—Motor bicycles, motor tricycles and motor quadricycles.

Public Service Class—Public conveyances and freight conveyances. These shall carry a minimum weight of 750 lbs., exclusive of their driver.

The test will occupy six days, and the speed conditions will be based on an average rate for the six days. Any competitor falling below an average of 8 miles an hour for any one period will receive no credit for that period, and no average speed exceeding 15 miles an hour will be recognized. Three grades of certificates of honor will be awarded—first, for an average speed of 12 to 15 miles an hour; second, for an average speed of 10 to 12 miles an hour, and, third, for an average of 8 to 10 miles an hour.

The route for each of the six days will be divided into the following six stages:

First Stage—From clubhouse to Poughkeepsie; approximate distance, 90 miles.

Second Stage—From Poughkeepsie to Albany; approximate distance, 70 miles.

Third Stage—From Albany to Little Falls, including a hill-climbing trial near Little Falls; approximate distance, 85 miles.

Fourth Stage—Little Falls to Syracuse; approximate distance, 85 miles.

Fifth Stage—Syracuse to Rochester; approximate distance, 90 miles.

Sixth Stage—Rochester to Buffalo; approximate distance, 80 miles.

The contest is open to all classes of self-propelled vehicles, but no manufacturer, agent, or private owner will be allowed to enter more than three vehicles in any one class.

The Trolley in Massachusetts.

The subjoined statistics give the development of the trolley system in Massachusetts during the last 10 years:

	1900	1890	Increase.
Number railways	118	78	40
Total mileage	2,037	612	1,425
Electric mileage	1,908	160	1,748
Gross liabilities	$95,062,946	$25,611,989	$69,450,957
Capital stock	48,971,168	14,879,130	34,092,038
Total income	21,387,641	8,388,015	12,999,626
Net earnings	6,839,693	2,104,077	4,735,616
Capital earning dividend	38,901,700	....	....
% earned	6.68	....	....
Capital without dividend	10,069,467	....	....
% dividend all capital	4.92	6.77	*1.85
% expense to earnings	65.80	74.80	*9.00
No. passengers	395,027,198	164,073,846	230,953,352
Gross per mile	$10,452	$13,632	*$3,180
Exp. per mile	6,878	10,197	*3,319
Net per mile	3,508	3.435	73
Gross per passenger	5.06c	5.06c	....
Expense per passenger	3.33c	3.79c	*.46c
Net per passenger	1.73c	1.27c	.46c
No. employees	12,766	6,246	6,520
No. cars	6,531	3,247	3,284
Horses	455	11,241	*10,786

*Decrease.

Mileage has increased more than three-fold; investments nearly four-fold; income less than three-fold; passengers less than two-fold, and at the same time while gross earnings and expenses per mile declined largely, the net per mile was somewhat larger in 1900 than in 1890. The economy in operation is also reflected in the increased net earnings per passenger; 1.73 cents in 1900 compared with only 1.27 cents in 1890. The adoption of larger cars is shown in the increase of only about 100 per cent in number of cars and number of employees.

The reduction in horses from over 11,000 to less than 500 indicates the removal of the horse as the prime factor in street car transportation prior to 1890.

The net returns upon the total capital invested shows a decrease for the decade of about 1½ per cent. But if the Boston Elevated's capital is deducted the earnings upon the remaining capital would be above 7 per cent in 1900, an increase of about ½ per cent over 1890.

The Successful Scot in America.

Note was made in these pages recently of the appointment of Mr. H. G. Stott to the Manhattan Elevated Railway. Professor Andrew Jamieson contributes the following story to the Glasgow *Evening Times*, which is worth reproduction here: "I have just received a copy of your *Evening Times* of the 6th inst., containing an extract from the *Illustrated Buffalo Express*, which gives an account of my old student, Mr. Henry Gordon Stott, who has recently received the important appointment of superintendent of the motive power department of the great Manhattan Electric Railway Company in New York City. As the first technical adviser and stimulator in Mr.

Stott's career, I read your article with special interest and pleasure. Although I could give several instances of his pluck and perseverance, I shall only describe one of these at present. One day, in 1884, when engaged in my electrical laboratory at the College of Science and Arts, I received notice from a well-known Clyde shipbuilding firm that they desired to have the electric lighting installation in one of their new ships tested and reported upon. Being unable to leave my classes for such work until the following Saturday, and being desirous of having a preliminary test and report, I asked a fine young Englishman if he would go down the Clyde with my instruments and make the necessary tests, etc. He replied: 'Where shall I get my dinner, sir?' I shrugged my shoulders and turned to a Scotchman from the borders with the same query. He said: 'When shall I get home, sir?' In utter despair, I said to young Stott (whom I had brought from Orkney), 'Please go down the Clyde to the Gareloch with these instruments and come back when you have finished the tests.' The reply came instantly, 'Aye, aye, sir,' in proper sailor-like fashion. He appeared about 8 p. m. at my house with the results taken exactly as requested. I said, 'Have you had anything to eat?' 'Nothing, sir, since breakfast.' My wife soon provided a substantial supper for him, and there the preliminary canter ended.

"Within a week I had a letter from the general manager of the Anglo-American Submarine Telegraphic Company, asking if I could send a junior electrician to him at once, as their ship was leaving London very soon to repair one of the Atlantic cables. I went direct to Mr. Stott, and before all the other students who had heard of the previously mentioned case, I said: 'Mr. Stott, come here. Pack up at once and go to London. Take this letter to the general manager of the Anglo-American Cable Company, and let me know how you get on.' 'Aye, aye, sir,' was the reply, and away he went at once, after bidding good-bye to myself and his fellow students. I could give many other instances of my old students forging ahead to the top of the tree in different parts of the world, but none with a better moral for young Scotchmen than this one."

Trolley in the Canary Islands.

Mr. S. Berliner, United States Consul at Teneriffe, Canary Islands, writes the State Department as follows: The electric tramway connecting the port of Santa Cruz with the town of La Laguna will be open to the public on March 15, 1901. Besides carrying passengers, the managers have trucks for moving freight, principally fruit, which is the main export from this island. The power house is situated at La Cuesta, a little over half way (about 3 miles) between the two towns and at an elevation of 960 ft., La Laguna being 1804 ft. above the sea level and distant a little over 5.6 miles. The cars start from the mole at the port and run through the principal street up the main road, which is built on a zigzag plan on account of the grade. It is but a single track, with switches at every kilometer, except in the town of Santa Cruz, where it runs up one and comes down another street. It is an overhead-trolley system, the wires being strung on poles, some of wood and others of iron. In the towns, it is strung over the street from house to house by rivets driven into houses opposite each other and connected with a wire.

The concession for this road was granted at Madrid and includes the whole of the road between Santa Cruz and Orotava. From the present terminus, there will be a regular service of automobiles to the town of Orotava until the tramway is finished. The total length of the line will then be 27 miles. The company is known as Cia. Electrica de Tramvia de Teneriffe. It is a Belgian company, and is capitalized for 1,600,000 francs ($308,800). The rails, rolling stock and machinery were imported from Belgium, although part of the same was originally from Italy, France and the United States. It is a 3-ft. 3-inch gauge, and the concession provides that the road must be finished within five years.

There is also a concession for an electric tramway of double-track system between the ports of Luz and Las Palmas, in the island of Grand Canary, which has been granted to a Belgian company. The road will run along the seashore front and will extend from 4 to 5 miles. It will be a great improvement and no doubt a better paying investment than the Santa Cruz-La Laguna road, as Las Palmas is now virtually the principal town of these islands, and is doing about double the business of Teneriffe.

Tragic Death of Mr. I. H. Farnham.

THE LATE I. H. FARNHAM.

Consternation and deep regret were caused throughout telephonic circles by the receipt of the following dispatch on April 24 from Portland, Me.: "Insanity seems to be the only theory of the cause of the shooting in the New England Telephone Company's central office this afternoon, whereby Chief Electrician I. Henry Farnham, of Wellesley, Mass., met with instant death and three electricians were wounded, one of whom died later, by Geo. H. Brainard, of Boston, a foreman of a construction crew. Brainard's wife, who has made her home here with him during the three months he has been in charge of alterations in the telephone office, says he has been nervous lately, and that he slept hardly any in the last two nights. She says so far as she knows he had only kindly feelings toward the chief electrician and the crew. Seven men were at work in the upper story of the telephone office building when the shooting occurred. Without warning, Brainard drew a revolver from his pocket and rapidly fired three times at Chief Farnham. All three bullets took effect, one in the throat, another in the right side and the third entering the region of the heart and passing entirely through the body. When Farnham fell, Brainard opened fire on three other electricians in the room, wounding them all. Two men who were working behind the tall switchboard escaped, probably because the murderer was not aware of their presence in the room. At the hospital to-night it was reported that the two wounded were in a critical condition, with the chances against recovery. Deputy Marshal Frith, who grappled with and arrested the murderer, was shot at, but received only a trifling wound. The bullet passed through a package of letters in his coat pocket, and its course was diverted by contact with a pocket mirror."

Mr. I. H. Farnham, who was thus so cruelly and suddenly killed, was one of the most highly esteemed members of the electrical fraternity. He began in the telegraph field with the old American Company in 1866, and was with the Western Union Company for years. He had been actively engaged in telephony since 1879, and was for some time managing electrician, superintendent, etc., of the Maine Telephone Company. He took out several patents on improvements in the telegraphic and telephonic arts, and was noted for his skill and expertness as a telephone engineer. He joined the American Institute of Electrical Engineers in 1887, and his paper on electrolysis due to stray underground currents was probably the first authoritative treatise on the subject. It remains in continued demand up to the present time. Mr. Farnham was still a comparatively young man, having been born at Woolwich, Maine, Nov. 2, 1853. His loss is severely and deeply felt by his family and by a wide circle of appreciative friends. The portrait here shown is believed to be the latest and is taken from the group picture of the clam-bake of the American Electrical Works, at Providence, last summer. It is a sad coincidence that in the same row with Mr. Eugene F. Phillips sat Mr. Farnham on one side and Dr. Elisha Gray on the other

April Meeting of the American Institute of Electrical Engineers.

At the meeting of the Institute of Electrical Engineers, April 26, a proposed new constitution for the Institute was submitted, final action upon which will be taken at the annual meeting of the Institute in May. Two papers were read before the meeting, one by Professor Harris J. Ryan on "The Transformer for Measuring Large Direct Currents," and the other by Mr. F. W. Brady on "Electricity in Mountain Mines."

Professor Ryan in his paper described a method in which a low-reading ammeter may be used in the measurement of very large direct currents. The method is as follows: A special transformer has a coil of a number of turns, in the circuit of which is connected the low-reading standard ammeter and a water rheostat; a second

coil of a single turn is connected in circuit with the large current to be measured. The two coils are so mounted on the special transformer that magnetic leakage is reduced to a minimum. Surrounding the magnetic circuit of the transformer are two smaller coils, one of which is connected with a source of alternating current, and the other with a galvanometer. When measurements are being made the amount of current passing through the standard low-reading ammeter is varied until the deflection of the galvanometer becomes a maximum. Since the alternating current is constant in value it follows that at this point the permeability of the magnetic circuit is at a maximum, and in order for this condition to exist there should be no flux in the circuit from the direct-current coils. In other words, at this point the ampere-turns of the single coil will be equal to the ampere-turns of the multiple coil in circuit with the low-reading ammeter. Knowing the ratio of the turns of the two coils, the large current flowing through the single coil will be that indicated by the standard ammeter multiplied by the ratio of turns.

The paper by Mr. Brady is descriptive of several electrical installations for mining purposes in the Rocky Mountains. The paper is interesting from the description which it gives of the manner in which the obstacles to transportation of machinery over rugged mountain trails were overcome, and from the indications contained as to the kind of installations that are suitable for the duty called for in the cases described.

Transformer Patent Litigation.

Judge Coxe, of the United States Circuit Court of the Northern District of New York, has handed down a decision in two suits of the Westinghouse Company against the Saranac Lake Electric Light Company, alleging infringement of two patents on transformers.

One of these patents was granted Sept. 24, 1889, to Rankin Kennedy on the use of transformers in parallel on a primary circuit. In June, 1883, Kennedy, in an article published in the *Electrical Review*, of London, relating to the use of transformers in parallel, says: "In parallel arc, however, the secondary generator is a beautiful self-governing system of distribution; but what about the size of the conductors for such a system? Prodigious!" In a letter published in the same journal, Nov. 19, 1886, Kennedy takes issue with Zipernowski and Deri concerning their claim that they were the first to make "the simple connection of secondary generators in parallel arc." He maintained that he was the first to do this, and wrote: "I then thought of and tried parallel arc connection and perfectly succeeded in obtaining self-regulation. There certainly is not much visionary about that; the visions of a monopoly I am afraid are all on the other side, and my experiments and published results are likely to somewhat mar the beauty of monopoly visions. * * * I do not know anything about 'rational methods of connections of transformers.' I know only two methods of connecting to the main—series and parallel—both of which methods it is open for anybody to apply to any form of transformer." The Court considers there is no escape from the conclusion that Kennedy intended that the public should have whatever he had contributed to the art in the 1883 articles referred to, and that the 1886 letter is to be construed as an abandonment of the invention.

The Stanley patent in suit was granted March 1, 1892, upon an application filed Aug. 15, 1888. The invention to which the patent refers was put in use at Great Barrington, Mass., March 16, 1886. The claims involved in the Stanley patent are the first and third, and relate to the use of transformers in multiple arc, each transformer being "made with a primary coil containing such length of wire exposed to magneto-electric induction that when operated by the dynamo with which it is to be used with its secondary circuit open the electrical pressure and counter pressure in the primary circuit shall be equal with incandescent lamps or other translating devices in the secondary circuits." The above quotation is from the first claim, and the following from the second claim. "Each converter is adapted to the dynamo operating the system by making its primary coil of such length that when supplied with its full proportional share of the entire normal e. m. f. of the machine, its secondary circuit being open, the electrical pressure and counter pressure in its primary circuit shall be approximately equal with translating devices in the secondary circuits of the converters, to be cut out of circuit when not in use without the introduction of any resistance in place of them."

The following is Judge Coxe's construction of the bearing of the above claims:

"Stanley's contribution to the art of electric lighting is an improvement upon the method described in the Kennedy patent. It still remained to discover a way to prevent the varying-candle-power of the lamps on a given transformer when a part of the lamps were turned off or on. If, for instance, there were 20 lamps on the transformer, and all were burning, the turning off of 10 would change the candle-power of the remaining 10, increasing the luminosity. If they were turned on again the candle-power of all would go down.

"The difficulty was a serious one and electricians generally were searching for a solution, but always along the same lines. Stanley found a solution by doing what no one had ever thought of doing before. He discovered that he could remedy existing faults by regulating the length of the wire on the primary coil of the transformer. The patent tells those skilled in the art how to accomplish this result. To the uninitiated Stanley's rule seems indefinite and obscure, but electricians have no difficulty in understanding it. He determines the correct length of the primary coil by winding on wire after the transformer, in circuit, is connected with a dynamo, until the loss of voltage represented by the formula C^2R equals the predetermined loss of energy to be suffered in the system. The length of the wire is varied until the desired results are attained.

"What Stanley did was an exceedingly valuable addition to the art. He remedied a serious defect; he secured, without unnecessary waste of current, constancy of secondary pressure as lamps were turned on or off; he struck out into a new path and brought back the prize, which, if he had continued upon the old paths, he never would have found. Such a discovery cannot be attributed to the 'skill of the calling.'"

The Court held that an article in the London *Electrical Review* of August, 1885, describing the Zipernowski and Deri plant at Budapest, in which transformers were employed in parallel, did not furnish an anticipation of the Stanley patent, for the reason that "the article in question imparts no information upon the one subject which is the all-essential feature of the Stanley invention—the length of the primary wire and the method of determining the same. * * * It fails to tell electricians how the length of the primary wire can be correlated to the voltage and alternations of the current supplied."

The Court sustained the Stanley patent.

Telephony in Mexico.

The annual report of the Mexican Telephone Company for year ended Feb. 28, 1901, has been issued. It is as follows:

	1900-01.	1899-'00.	1898-99.
Tel. in service	3,501	3,065	2,726
Rentals for year.....	$172,905	$149,137	$130,026
Gross earn. in Mex....	187,466	160,640	138,937
Gross exp. in Mex....	102,635	93,251	82,497
Net earn. in Mex	84,830	67,388	56,440
Operating expenses....	75,798	71,334	67,347
Maintenance	26,836	21,916	15,149
Construction	58,697	34,333	35,782
Taxes	8,052	7,398	6,709
Net rev. U. S. cur....	35,803	26,519	21,337

The average equivalent received for Mexican dollars for the year was 49.24 cents in gold. In the City of Mexico exchange 25,600 ft. of cable have been hung during the year, at a cost of $21,600. It will be necessary during this year to add about 24,000 ft. of new cable.

Another 300-line addition was made to the City of Mexico switchboard at a cost of $4,587. If the present rate of increase continues it may be necessary to make another addition to the switchboard the coming year. The plant has been improved to the extent of $58,697 the past year, and was never in better condition than at present. The gain per subscriber in the gross earnings in all the exchanges over the preceding year was 72 3-5 cents, the decrease in expenses per subscriber $1.3441, making a total gain per subscriber of approximately $2.07.

Long Distance Hypnotizing.

A test of hypnotizing over telegraph and telephone wires between Denver, Colo., and Pueblo, 120 miles, is reported by the Colorado papers. Apparently the ability to do such a thing has been proved once more, but the utility of it as a new industry was not clearly established.

CURRENT NEWS AND NOTES.

TROLLEY PARCEL TRAFFIC.—Attorney General Knowlton, of Massachusetts, has rendered an important opinion in relation to the question of the constitutionality of the bills authorizing street railways to carry merchandise in small packages. Mr. Knowlton has stated that the bills are constitutional.

THE BRITISH PACIFIC CABLE.—A San Francisco correspondent informs us that the western cable landing of the British Pacific cable has been located at Barclay Sound, on the west coast of Vancouver Island. A town will be laid out and cottages built for the cable employees on the 100-acre site.

GERMAN ELECTRICAL INVESTMENT.—The principal electric manufacturing companies in Germany with their finance companies, have a paid in share capital of about Mks. 369,300,000 and 205 millions bond capital. This makes in total a working capital of Mks. 574,300,000 or about 136 millions of dollars. The dividends paid last year, together with the interest on the bonds, amounted to something over ten millions of dollars.

TELEGRAPHONE TEST.—A successful test of the telegraphone in connection with long-distance telephonic transmission was recently made on a Boston-New York telephone circuit. Mr. T. D. Lockwood, of the Bell Telephone Company, spoke to the instrument in Boston and the conversation was recorded by the telegraphone and subsequently reproduced by it with great distinctness. A test between New York and Chicago was not so successful owing to its having been made during extremely wet weather.

FOUR-FIFTHS OF A MILE SPAN.—The Bay Counties Power Company has accomplished the feat of stringing four electric power cables across the Straits of Carquinez, near Benicia, Calif. It is claimed that the span of 4400 ft. between the towers is the longest of the kind in the world. The sag, or deflection from a horizontal line, is 135 ft. The cables were manufactured of plow steel, and are seven-eighths of an inch in diameter. They are insulated at both the towers and the anchors by special devices involving original methods in electrical engineering. These cables are the largest of their kind, and carry a higher potential than those of any similar span.

ELECTROLYTIC COPPER REFINING.—The New York papers last week contained despatches from London of a sensational character relating to a revolutionizing electrolytic process, the American rights of which, it was stated, had been secured by Senator W. A. Clark. According to the newspaper accounts the process will work a revolution in the copper industry, enabling a saving of $100 per ton to be made in transformation from the ore to the completed article of commerce. What little information concerning the process was given would appear to indicate that it is the well-known Cowper-Coles process, whereby instead of copper being deposited in the electrolytic bath as rough cathodes, commercial tubes, bars or plates are formed at the cathode in the process of electrolytic refining.

CALCIUM CARBIDE.—It is now well understood that the formation of calcium carbide may proceed to a very appreciable extent after the charge has left the arc or main heat zone of the furnace, provided the formed carbide be kept in contact with the unconverted raw material, at a sufficient temperature, and out of contact with air. In a patent issued April 23, Dr. Frölich, of Steglitz, Germany, proposes a means to this end consisting of an elbow-shaped tube connected with the tapping hole of the furnace, and provided with a suitable closure, which may be either a trapdoor or a flexible asbestos tube. The too rapid cooling of the product, which has a tendency to prevent the desired after-formation of carbide, is prevented by burning the reaction gases, consisting mainly of carbon monoxide, in an annular muffle surrounding the tube, the gases being withdrawn for this purpose through the tubular upper electrode.

WELDING ALUMINUM.—The thin surface coating of oxide always present upon aluminum renders it extremely difficult to effect a perfect union of two surfaces of the metal either by soldering or welding, and especially at the high temperature required for the latter operation. In a patent issued April 23 to Max Schmidt, of Berlin, Germany, it is proposed to accomplish this by effecting the decomposition of this oxide by electrolysis. To this end the aluminum surfaces to be joined, previously heated to a welding temperature, are placed in a slightly separated relation and connected as the cathode of a circuit of low voltage and high amperage. A rod of graphite or platinum, constituting the anode of the circuit, is then passed between and in contact with the edges of the seam, thereby removing the oxide layer, in part mechanically and in part by electrolytic reduction. The welding operation may then be effected without hammering or pressure.

WIRELESS TELEGRAPH PLANS.—A special cable dispatch from London of April 27 says: The Marquis of Londonderry, Postmaster-General, received a deputation of the directors of the Marconi companies yesterday. They ask for a license for the transmission of wireless messages within territorial waters between ships and land stations. The post office, which, of course, controls the telegraph, has a monopoly that extends to the three-mile limit. The deputation also asked on what terms the companies might organize sea telegraphy, expressing confidence that a business man at sea would like to maintain daily relations with the chief centers of trade, and that many passengers would like to communicate with their friends on shore, all of which would add to the revenue of the Post Office Department. They also asked for a license in order to arrange for dealing with telegraphs to and from foreign places and for land purposes. The Marquis of Londonderry promised to consider the matter and consult the heads of the various departments concerned. The reply was not considered very satisfactory.

STREET RAILWAY STANDARDIZATION.—The Committee on Standardizing of Street Railway Equipment, appointed at the recent meeting of the executive committee of the American Street Railway Association, has begun active work with a view to presenting a comprehensive report on the subject at the annual meeting of the association in October next. Mr. T. E. Crossman has been appointed secretary to the committee, and in conjunction with the members of the committee, he will visit some of the leading manufacturers of street railway equipment to ascertain their views on the subject of standards. The members of the committee are John R. Graham, Lynn & Boston Railroad Company, Boston; N. H. Heft, Meriden Electric Railroad Company, Meriden, Conn.; Frank G. Jones, Memphis Street Railway Company, Memphis; Willard J. Hield, Twin City Rapid Transit Company, Minneapolis; Conway F. Holmes, Metropolitan Street Railway Company, Kansas City. They request that all who are interested in the subject will correspond with the secretary of the committee, whose address is 1829 Park Row Building, New York, prior to May 20, at which time a meeting of the committee will be held in Buffalo. We trust our readers will communicate their views to the committee.

GERMAN LIFE-SAVING APPARATUS.—Consul-General Guenther, of Frankfort, March 20, 1901, informs the State Department of a recent improvement in the means for saving life at sea. It has often happened, says the Consul-General, that on account of darkness, life belts could not be seen when thrown to persons who had fallen overboard at night. Buoys with life belts attached and supplied with 8-cp electric lights have been constructed heretofore, but their use was confined to vessels equipped with electric-lighting plants, and their heavy weight, requiring three or four men to handle them, was a serious handicap. The new apparatus weighs but 33 lbs. and produces a light equal to 150 candle-power. The buoy is of a globular form, carries from two to four life belts, and supports a long cylinder of sheet tin having 12 compartments filled with carbide of calcium. These compartments are arranged at different elevations. When the apparatus is thrown into the sea the water passes through perforations in the bottom of the cylinder and, coming in contact with the carbide, generates acetylene gas. Each compartment is connected with a burner by a pipe, proper valves preventing the escape of the gas other than through the burner. When the volume of gas in the cylinder decreases, hydrostatic pressure opens the valves and allows water to enter the next compartment to generate an additional supply of gas. The gas is lighted electrically, and ignition takes place in about 25 seconds after the buoy is thrown into the sea. The flame is protected from the wind by glass and burns steadily and with great intensity for three or four hours. Cleaning and filling the apparatus require only a few minutes. The cost of a charge is about 12 cents.

TROLLEY FREIGHT.—An ordinance in Detroit allows the street railways to carry freight within the city limits.

AUTOMOBILE SPEED.—The State Department has been prevailed upon by those who believe there should be general restriction of the speed of motors in cities, to procure from consuls of the United States reports showing the rules in force in foreign countries that have been constrained to apply rules.

MARCONI STATION IN ENGLAND.—A London despatch states that Marconi's wireless telegraph company is erecting a station on the mainland of England nearest Fastnet Rock. All vessels fitted with the transmitter will be able to report themselves when they are many miles beyond the rock and thus avoid threading the passage separating it from the mainland.

CHEAP PRODUCER GAS.—A cable dispatch from London of April 29 says: The Daily Chronicle says it learns that Dr. Ludwig Mond has discovered a method of producing illuminating coal gas at twopence per 1000 feet, which will effect a revolution by cheapening electric power, and also as bearing upon the production of open-hearth steel.

GOVERNMENT TELEGRAPHS.—In an address before the Presidential Postmasters' Association, of Ohio, Congressman Dick, Chairman of the Republican State Committee, declared himself in favor of Government control of telephone and telegraph lines. All means of communication, he declared, should be under Government supervision, telegraphic and telephonic, as well as the mail system, and added that this is certain to come. The United States finds, he said, that the surplus of its products must be disposed of in the markets of the world. It must not only protect but aid its commercial interests, and in commerce it is an advantage that communication be not only swift but inexpensive. If a telegraphic communication can be sent by the Government for 5 cents, then a private corporation must not be permitted to charge and collect 25 cents for that service. The means of communication ought to be the Government's monopoly not that of a private corporation. Gen. Dick also declared himself emphatically in favor of a postal savings system.

DETECTING TELEPHONE LISTENERS.—A special dispatch from Stockholm, Sweden, of April 10, says: An employe of the Stockholm Telephone Company has invented a device by which the telephone user can tell when a third party is listening to his conversation. The visible part of the device is a small metal box with a glass front. This is attached to the wall or desk near the telephone instrument. The pressing of a button connects the "listener detecter," as it is called, with the telephone. The intrusion of "central" is indicated by the illumination of a red Maltese cross behind the glass of the "detecter," which remains lighted up as long as "central" is on the wire. The connection of the operator at the second exchange with the wire is indicated by the illumination of a white cross, so that the telephone patron can tell not only when and how long the operator is on the wire but also which exchange "cuts in" to ask him whether he is through talking or to listen to what he is saying. The device, including its installation, costs less than $2, and is being put in by a large number of business houses which use the telephone for transacting more or less confidential business.

LETTERS TO THE EDITORS.

Vacuum Tube Lighting by Metallic Vapor.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of April 27, 1901, there is an editorial on the Hewitt vapor lamp. I here state that the discovery of vacuum tube lighting by metallic vapor was not made by Mr. Hewitt. In my "Notes on Light," which have been appearing in one of your contemporaries for four years, such a lamp is described and figured, the mercury cathode being shown. This note was printed more than 15 months ago, and the experiment had been tried successfully in the summer of 1896, the same results being arrived at. Also in the *American Journal of Science* for November, 1900, in my paper on X-light, in which a brief account of some of my vacuum tube work was given, I spoke of the tube and said it gave a brilliant light. That an experimenter does not care to waste his time by going into commerce to exploit his observations unless they can be used to relieve human suffering is no reason why his results should be ignored and the work credited to subsequent inventors.

You speak of the probability that such tubes may be of scientific interest. This is quite true, for this form of tube has already served to disprove the theory that the cathode stream particles are the ultimate units of either matter or elecricity, and has thrown light on other difficult problems in physics. You also speak of the impossibility of using the light on account of its color. It is a simple matter to change this color by alloying the mercury.

BOSTON, MASS. WILLIAM ROLLINS.

[Has Mr. Rollins actually demonstrated that it is a simple matter to change the color of the light by alloying the mercury, and at the same time retain the remarkable properties of the plain vapor lamp? —EDS.]

Instruction in Electro-Chemistry.

To the Editors of Electrical World and Engineer:

Sirs—I have read your recent editorial on "Electro-Chemistry" with great interest. I cannot agree with you that "in this country the instruction in electro-chemistry is evidently largely based upon the theories and methods current a quarter of a century or more ago," for I am sure that if you were to visit the large technical schools and universities you would discover that they are thoroughly conversant with the most recent ideas of the Arrhenius-Van't Hoff-Nernst-Ostwald school, and that excellent research work is being done in accordance with these views.

I do, however, concur with you in the thought that more attention should be given to undergraduate instruction in this field along practical lines. The future chemists and chemical engineers should receive drill in this direction as well as in other fields of chemistry. In our own University we began instruction in electro-chemistry as early as 1878. The direction taken was in analysis, in the extension and use of the current, with all the metals which would respond to it. The result has been that a number of useful, rapid, practical metal separations were developed, and have met with extended application.

It may perhaps be not improper to add that our seniors in chemistry study in our electro-chemical laboratory such problems as the dependence of fall of bath pressure in the electrolyte upon current density, concentration and temperature of solution; the influence of current density and concentration upon the course of electro-chemical reactions; the application of gas analysis to the study of electro-chemical reactions (formation of hypo-chlorites and chlorites); the electrolysis of hydrochloric acid with a diaphragm; ion transference; the formation of persulphuric acid; metal precipitations with soluble and insoluble anodes (copper refining); the Siemens' copper process; experiments with molten electrolytes; experiments with multipolar electrodes; the electrolysis of salt solutions with mercury cathode; the application of the current to the oxidation and reduction of organic compounds, and the study of reactions in the electric furnace. In the latter we have recently prepared a number of new and perhaps commercially valuable alloys. This sketch will afford you an idea of the direction in which we have been pushing, and, I may add, that graduate students are being attracted to the course.

As to the literature in the English language upon the above subject, I think that there is an abundance, one of the most recent contributions being Blount's "Practical Electro-Chemistry," which deserves favorable mention. EDGAR F. SMITH.

UNIVERSITY OF PENNSYLVANIA.

Aluminum Wire for Interior Work.

To the Editors of Electrical World and Engineer:

Sirs—The Underwriters' rules for wiring forbid the use of smaller wire than No. 14 (B. & S. gauge), presumably on account of the lack of mechanical strength of the smaller sizes. In many cases, such as the supplying of current for a single lamp, or for more than one lamp on a 220-volt current, the current-carrying capacity of a smaller wire would be ample. Why might not an aluminum wire of No. 14 gauge be substituted for copper in such cases with economy? For inside wiring its strength would be sufficient. Its carrying-capacity is given by the 1901 rules as 10 amperes for weather-proof insulation, and 13 amperes for rubber covered (84 per cent of copper

of same size). Its resistance would be nearly double that of copper, but for short runs this would not be prohibitory. Since aluminum weighs but 3-10 as much as copper, at twice the price per pound it would cost 6-10 as much for same size and length bare. The insulation would cost the same as for copper wire, hence if the insulation of No. 14 weighs the same as the copper, the final cost of weather-proof aluminum wire No. 14 would be 8-10 that of copper, or, say, $4 per 1000 ft. for aluminum as compared with $5 for copper. In the case of rubber covered wire the cost of the metal bears a smaller proportion, but the price of $14 rubber covered aluminum should be about $9 per 1000 ft. to $10 for copper.

To permit ready soldering, could not the aluminum wire be tinned just as the copper wire is generally tinned before being insulated with rubber? There is so much No. 14 wire used that a saving of from 10 to 20 per cent would be important. The above was suggested by the editorial regarding aluminum lines in your paper of April 20.

MORGAN BROOKS.

LINCOLN, NEB.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Large Generators.—PICHELMAYER.—A communication referring to the article of Robert (Digest, March 23). He says it is not yet decided whether the American designers are right in entirely neglecting the Arnold winding. Parshall's designs are not exclusively typical for American dynamo design. There are also the designers of the Westinghouse Company, "the machines of which are built according to the principle. Many lines of force and few windings. The whole development of the dynamo design consists to a large degree in a slow, but continuous increase of the intensity of the magnetic field, while in the first Siemens machine B was about 300, we have now already arrived at $B = 12{,}000$."—*Elek. Zeit.*, March 21.

REFERENCES.

Synchronous Converters.—MEYER.—An illustrated article on the calculations of synchronous converters. While in a synchronous converter a direct-current generator and a synchronous motor are combined, the more difficult part is that of building a good direct-current dynamo under aggravating circumstances. He discusses the choice of the frequency, number of poles and revolutions per minute, diameter, armature reaction, the allowable tension per commutator segment, current density in the armature wires, form of the slots and armature winding, flux of lines of force per pole and choice of the straying coefficient, choice of the density of lines of force in the single parts, determination of the breadth of the machines and of its parts, form of the pole shoes and length of the air-gap, exciting ampère windings per pole, commutator, efficiency. The article is concluded by some remarks on hunting.—*Elek. Zeit.*, April 4.

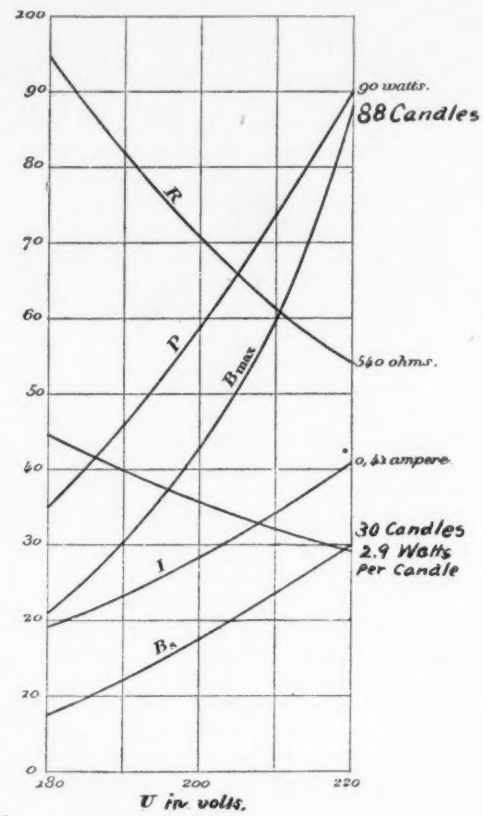
Calculations of Field Coils.—OSNOS.—An article supplementary to his former one (Digest, Jan. 19). He gives a simple method of calculating the field coils of a new machine which is to be predetermined.—*Zeit. f. Elek.*, April 7.

LIGHTS AND LIGHTING.

Train Lighting.—WALLITSCHEK.—A paper read before the Electrotechnical Society, of Vienna. In Europe there are at present more than 8000 cars electrically lighted, of which 620 are in Austria and Hungary. An Austrian railroad, which has used electric train lighting experimentally, gives the cost of a 6-cp lamp-hour as 0.6 cent. This railroad will continue to use electric train lighting. The German post office, which uses electric light for the mail cars, gives the cost of a 12-cp lamp-hour as 0.9 cent. On the Jura-Simplon Railroad the normal candle-hour costs 0.09 cent. He discusses the different systems of train lighting. He thinks the pure accumulator system will be the system of the future. In the discussion which followed, Dick said that the combined dynamo and accumulator systems is much cheaper than the pure accumulator system.—*Zeit. f. Elek.*, March 24, 31.

Electrolytic Arc Light.—MUELLER.—A brief communication referring to the article of Rasch, noticed recently in the Digest. He says that an efficiency of 100 per cent, as claimed by Rasch on account of his result of 5.21 candles per watt, is impossible, as there are certainly losses in the form of heat. Besides, in his tests of the Bremer arc light, Wedding has found in one case 10 candles per watt, which is nearly double that claimed by Rasch.—*Elek. Zeit.*, March 28.

Nernst Lamp.—E. H.—An article, illustrated by diagrams, giving an account of experiments made by an "anonymous correspondent" with a 220-volt 80-watt Nernst lamp. He first gives in diagrams the results of photometric measurements made at 220 volts in one horizontal and two vertical planes, and then the results of experiments in which he varied the voltage between 220 and 180. The results of the latter tests are shown in the adjoining diagram. The



NERNST LAMP TESTS.

abscissas represent the voltage, the curve I the current in amperes, the curve P the power in watts, the curve R the resistance in ohms, the curve B *max* the maximum luminous intensity in the axial direction of the lamp in candles, the curve B the average spherical luminous intensity in candles, the curve without designation represents the specific consumption in watts per candle. "It will be seen that a diminution of the voltage by 5 per cent causes a variation of the luminous intensity by 25 per cent. The specific consumption which is only about 1 watt per candle in the direction of the maximum, becomes 2.9 watts per candle for the average spherical luminous intensity. Below 180 volts the lamp is extinguished on account of the rapid increase of the resistance." It is thought that similar experience may cause the companies which own the Nernst lamp to hold it back, but it is believed that the difficulties will be overcome and that the Nernst lamp will be among the commercial lamps of the future.—*L'Ind. Elec.*, April 10.

POWER

REFERENCE.

Electric Power in Coal Mines.—RAVENSHAW.—A paper read before the Brit. Inst. Elec. Eng., in which he gives "some notes on the electrical transmission of power in coal mines." He discusses briefly the lighting installation, the generating plant, generators, switchboard, cables, switchgear for motors, motor starting switches, motors, pumping, haulage and coal cutting. He also describes briefly a number of accidents which have occurred in such installations.—Lond. *Elec. Rev.*, April 12.

TRACTION.

Electrolysis from Return Currents.—KROHN.—An account of measurements made by him in a town where in former years electrolysis of gas and water pipes had been observed. The power station is near the one terminal of one of the main lines, and the return current of nearly the whole network flows through the rails for a length of about 0.9 mile. Parallel to the rails, in the same street, there are water and gas pipes. These pipes had been destroyed by electrolysis at the points where the current must leave the pipes to reach the station which is 660 ft. from the rails. Later an artificial connection had been made at this point between the pipes and the rails. This prevented, of course, electrolysis at this point, but greatly diminished also the resistance of the circuit through the pipes, so that the stray currents through the pipes were greatly increased, and there was then a greater danger of electrolysis at points where two pipes are joined together. He measured the stray currents and found them to be 30 amperes in the average and to increase sometimes to 75 amperes in the gas pipes as well as in the water pipes. He, therefore, removed the artificial connection between the pipes and the rails. He then found the stray currents to be only 44 milliamperes in the average, i. e., about 700 times smaller. This result was so good that no special remedies against electrolysis became necessary. The good result is mainly due to the good rail-joints made in the last year, and to the fact that the rails had been placed upon a thick layer of sand and were thus separated from the earth. At the time, when electrolysis of the pipes had been observed, the electrical connection between the rails had been bad. He made an experiment with a Kapp inverse booster, by which half of the return current was sucked back to the station. He measured the stray current in the gas pipe again, and found it had also been reduced to one-half. The stray currents in the earth depend upon two circumstances: The voltage drop in the rails and the condition of the earth between rails and pipes. The latter condition is so important that he thinks it is unfair to give a strict rule concerning the voltage drop in the rails alone, as has been done in Great Britain. He recommends giving no other rules except the one that, after the railroad is in operation, in no gas or water pipe is a current allowed of more than 1 ampere per 3 cm diameter. Otherwise the railroad company must provide a remedy.—Elek. *Zeit.*, March 28.

Combined Trolley and Conduit System.—CONNETT.—The first part of an illustrated reprint in full of his paper, an abstract of which was noticed recently in the Digest. He first discusses the general type of conduit. He believes that from an operating standpoint the center slot is a better construction than the side slot. The inherent difficulty with the side slot is the switch at the junction of two slots. With the center slot, a comparatively light movable tongue can be hung or pivoted to the fixed tongue, its use being simply to guide the plough. With the side slot the tongue is much stiffer and heavier, because it must also guide the wheels of the car and support them in one position; i. e., the entire tongue is movable and its upper surface from point to heel must be level with the wheel rail. At its point it should have a certain thickness to give mechanical strength. Another objection to the side slot is that the flanges of the wheels throw water and mud into the conduit and onto the plough. The advantages of the side-slot conduit are that the additional band of iron in the street required by the center-slot rails is avoided, and that the maintenance of the paving is thereby simplified, every joint of a rail with the paving being a source of weakness in the life of the latter. He then discusses the mechanical and electrical details to be considered in the construction of a conduit. The ironclad porcelain insulator is strong, durable and cheap. There can be no hesitation about its use. The insulators should be vertical, so that they may not offer the chance for the accumulation of dirt, which can easily happen with one horizontally placed. He then discusses the method of attaching the insulator to the conduit construction, and gives some notes on the switches.—Lond. *Elec.*, April 12.

Electric Locomotive.—DROUIN.—An illustrated description of electric locomotives built by Brown, Boveri & Co., together with a Swiss locomotive building firm, for a French railroad company, to be used on high grades near Lyon. At a speed of 5½ miles per hour they can draw trains of 28 tons, either on ordinary track on grades up to 6 per cent, or with the aid of rack and pinion on grades up to 19 per cent. The weight of the locomotive is 12 tons. For running on ordinary track and with rack and pinion, there are used two entirely distinct systems of motors. On ordinary tracks the locomotive is driven by the usual 25-hp tramway motors, which drive the axle by simple reduction. For the rack and pinion system a single 150-hp motor is used, running at 700 revolutions and driving the wheels by a double gearing. This latter motor is placed inside in the frame so that it can be left open in order to facilitate ventilation. It is excited in shunt, and the excitation is variable. The increase of excitation is utilized as well in starting as on down grades, the motor being used as brake and furnishing current to the line. Current at 500 volts is supplied to the locomotive by two trolley poles.—*L'Elec.*, April 6.

Tramway Motor.—An illustrated description of a new tramway motor of the Gen. Elec. Co., of Berlin. The observation has been made that in the tramway service the increase of temperature is generally higher in the magnets than in the armature, although the usual workshop tests with a voltage of 500 volts, gives the increase of temperature about equal in magnets and armature. In the design of the new motor larger dimensions have therefore been chosen for the magnet coils. At 500 volts and 60 amperes it gives about 35 horse-power at 490 revolutions. The efficiency is 87 per cent at full load and 89 per cent at three-quarter load.—*Elek. Zeit.*, March 28.

Automobiles.—MUELLER.—A long, mathematical investigation of the influence of the wheel diameter upon the power consumption of automobiles. He finds that the power consumption is smallest when the weight of the automobile is equally distributed upon both axles, and if all four wheels are as large as possible. He thinks 2.5 meters is the largest wheel diameter that can be used with safety; 50 watt-hours per ton-kilometer is said to be the best that can be achieved at present with heavy automobiles having iron tires.—*Centralblatt f. Accum.*, March 15, April 1.

REFERENCES.

Indiana.—A long illustrated article on the power generating and distributing system of the Union Traction Co., of Indiana. There are 163 miles of track. Three-phase transmission is used, with converter sub-stations.—*St. R'y Jour.*, April 15.

Surface Contact Systems.—An illustrated article on surface contact systems, with detailed descriptions of the Westinghouse and the Dietto systems.—*Eng. News*, April 18.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Modern Central Station Practice.—C. F. SCOTT.—A paper read before the Franklin Institute on "Apparatus for power distribution from central stations." After some general remarks on modern tendency of consolidation, and on the development of the direct and the alternating-current systems in recent years, he describes the construction of the modern alternator. He discusses at some length parallel running of alternators with the aid of a mechanical analogy, by comparing the action of two similar engines carrying similar alternators upon their extended shafts which are connected to common bus-bars, and supply an outgoing circuit, with the action of two similar engines carrying similar gear wheels upon their extended shafts which drive pinions upon a common shaft which supplies power to an outgoing belt. He then deals with the synchronous converter. Alternators driven by belt or by waterwheels tend to give more favorable conditions than those directly connected to engines for driving generators which supply current to rotary converters, as the angular speed will usually have greater regularity. Other rotary converters and synchronous motors, as they are generators of e. m. f. in common with the alternators, may become disturbing elements, and a converter which may run smoothly under other conditions may behave very badly when a synchronous motor or another converter connected to the circuit at some distant point is not operating properly. This is, however, not true of induction motors. They have an opposite effect, and their presence on a system facilitates the operation of the rotary and also the parallel running of the generators. He then speaks of the induction motor, and emphasizes its effectiveness in service and mechanical reliability. It is ideal in that it admits of no adjustments or tampering by the ignorant or curious.

While the alternator will certainly be the generator of the future central station, there may be a divergence of practice in the consumption circuit, as the alternating current and the direct current are both adapted for this service. In practice it is necessary to utilize as far as possible the apparatus which now exists. It is, however, "obvious that the system and the apparatus which is most simple and reliable in its operation, is that which will probably be adopted ultimately. The alternating system, therefore, has naturally the first claim to consideration, and upon the broad principles of simplicity it is the one which has the first place, and the burden of proof lies with the direct current to show adequate compensation for the cost and complication which its introduction involves." He finally refers to the great possibilities of gas engines.—*Jour. Frank. Inst.*, April.

Polyphase Machinery in Sub-stations.—Eborall.—The last part of this paper, in which he concludes as follows: Given, that it is required to convert polyphase current into direct current by means of converting sub-stations, he draws the following conclusions: For power work and for those cases in which the amount of lighting to be done is relatively small, rotary converter sub-stations operated at 20 to 30 cycles are preferable. For lighting work the use of motor generators, operating at 40 to 50 cycles in the sub-stations, will give the best results. This is also the case when the lighting load on the sub-station forms a considerable proportion of the total output of the latter. Of the two classes of motor generator sub-stations, the one which is equipped with synchronous machinery is, on the whole, unsuitable for work of any magnitude. An account of the discussion which followed is also given.—Lond. *Elec. Eng.*, April 12. The paper is also continued in Lond. *Elec.*, April 12.

REFERENCES.

Automatic Switch.—Dary.—An illustrated description of an automatic switch, devised by Claude Raymond, for automatically closing and breaking an electric circuit at predetermined hours, especially for switching in lights automatically during certain hours.—*L'Elec.*, March16.

Batteries in Central Stations.—Abraham.—An article in which he describes some cases in which batteries in central stations were very badly treated in practice and gives some rules for handling a battery properly.—Lond. *Elec. Rev.*, April 12.

Wires, Wiring and Conduits.

Electric Wiring.—Clark.—A paper in which he first gives a comparative table representing, by figures, the values of the different properties of a perfect system, and the extent to which these properties are realized in several systems in practice. When the perfect system is characterized by the figure 100, he characterizes the system of screwed tubes by 65, simplex wires by 52.5, lead covered twin by 75, wood casing by 46. An installation of wiring should be complete in itself without the fittings, and the fittings attached so that they may be taken down at any time when painting or papering, or for cleaning the fittings themselves. He speaks in favor of standardization.—Lond. *Elec.*, April 12.

REFERENCES.

Equalization Mains.—Teichmueller.—A mathematical article on the mathematical theory of "equalization mains." He calls attention to the importance of the calculation of a network in such a way that a certain drop of voltage is not surpassed. An "equalization main" connects two points, the voltage of which is to be kept as nearly equal as possible under any circumstances; i. e., at any load. He first gives the general formulas of the problem, applies them to networks, and gives a numerical example.—*Elek. Zeit.*, March 14, 21, 28.

Wiring Rules.—Broadbent.—A paper deploring the lack of uniformity in the rules and regulations issued by British fire insurance companies, supply companies, etc., and urging that uniformity should be secured by the Brit. Inst. Elec. Eng. The same subject is discussed in an editorial.—Lond. *Elec.*, April 12.

Underground Cables.—Devey.—A long abstract of a paper read before the Glasgow section of the Brit. Inst. Elec. Eng. He discusses the following three systems: First, laying cables direct in the ground, armored or unarmored; second, pipe or conduit systems; third, solid systems. He thinks that probably the best system would be armored cable laid solid in wood troughs, with a minimum thickness of bitumen in 1 inch all around, the trough and covers to be of 1 inch thickness also. An account of the discussion which followed is also given.—Lond. *Elec. Rev.*, April 12.

Electro-Physics and Magnetism.

Leakage of Electricity from Charged Bodies at Moderate Temperatures.—Beattie.—He had already studied the leakage of electricity from insulated plates covered with different substances, the plates being charged with positive electricity to a potential of between 200 and 100 volts at a temperature between 300 degs. C. and 400 degs. C. In the present paper he gives an account of a number of additional observations at potentials of 1 or 2 volts, and with positive and negative charges. An examination of the various results given for small voltages shows that the effect produced in the heated atmosphere surrounding certain insulated substances, is of the same nature as the effect produced in the atmosphere surrounding bodies on which salts of thorium or of uranium are spread. The difference of potential between the mutually insulated metals depends on the nature of the metals, but not on their distance apart. The difference observed also changes sign when the substance, instead of being on the "one mutually insulated" metal, is placed on the other. With potentials of 200 volts there is a one-sidedness in the discharge from certain heated substances which does not show itself in the case of thorium or of uranium salts. This peculiarity may be compared with the discharge due to ultra-violet light. Here, however, it is the positive charge which leaks away, while the negative is retained.—*Phil. Mag.*, April.

REFERENCES.

Induction Experiments.—Guagini.—A description, illustrated by diagrams, of a series of experiments in which he endeavored to show "that it is possible to obtain in an induced circuit a current producing the same effect as a continuous current."—Lond. *Elec. Eng.*, March 29.

Röntgen Rays.—Peckham.—An illustrated summary of the present state of Röntgen-ray work.—*Sc. Amer.*, April 20.

Electro-Chemistry and Batteries.

Sulphuric Acid in the Lead Accumulator.—The first part of an article in which he calls attention to the great differences in practice of several German accumulator manufacturers regarding the concentration of the sulphuric acid which they use. He gives a list compiled from 15 price lists of different companies. This list shows that the concentration of the sulphuric acid used by these companies varies between 19.85 and 29.84 per cent. One company increased the concentration in recent years from 21 to 29 per cent, while another diminished it from 29 to 25. Sulphuric acid has a maximum conductivity at a concentration of 31 per cent. All manufacturers require the use of a concentration below this point. He then refers to the fact that the concentration of the acid increases during charging and decreases during discharging. If, therefore, only the conductivity of the acid is considered, the concentration must be chosen so that it is above 31 per cent after the charging and below 31 per cent after the discharging. He calculates that theoretically 1 ampere-hour corresponds to the production of 3.85 gr. lead, 4.44 gr. peroxide of lead, and 3.65 gr. sulphuric acid, and to the disappearance of 11.27 gr. lead sulphate, and 0.67 gr. water during charge. He shows numerically that a variation of the concentration is of great importance. He then begins to give an account of experiments which he has made. —*Centralblatt f. Accum.*, March 1.

REFERENCE.

Per-Iodate of Potassium.—Mueller.—An account of an experimental investigation of the electrolyic production of per-iodate of potassium.—*Zeit. f. Elektrochemie*, March. 21.

Units, Measurements and Instruments.

Electric Meters.—Janet.—An abstract of a paper read before the Internat. Soc. of Elec. on the electric meters at the late Paris Exposition. He discussed time meters, coulomb meters and energy meters. There is nothing new to be said about the meters of the first two classes. Regarding the O'Keenan meter he remarks that it is now used for counting telephone calls and for clocks with automatic winding. He exhibited a clock of this kind that will run for about 10 years without needing any care. The energy meters can be divided into three classes: First, the motor meters, which can be divided into meters with coils, as the Thomson meter, and the rotary

field meters; second, oscillating meters, as the Aron meter; and meters with discontinuous integration as the Siemens type. The type of meters with discontinuous integration which were to be seen in great number in the Exposition of 1889, seems now to be supplanted more and more by the motor meter type. He discusses several of the special meters shown in the 1900 Exposition.—*L'Eclairage Elec.*, March 2.

Influence of the Wave Form Upon Measuring Instruments.—BENISCHKE.—A brief article illustrated by diagrams and giving an account of experiments in which he investigated how far the readings of alternating-current instruments depend upon the wave form. He found that the "normal induction instruments of the Allgem. Elek. Ges." are almost entirely independent of the wave form, while electromagnetic instruments, according to the Kohlrausch system, in which a thin iron core is attracted into a solenoid, depend largely upon the wave form. The results of his measurements are given in diagrams.—*Elek. Zeit.*, April 4.

REFERENCES.

Industrial Magnetic Measurements.—MONTPELLIER and ALIAMET.—Continuations of their illustrated serial. These parts deal with industrial permeameters and magnetic balances.—*L'Elec.*, March 23, April 6.

Galvanometer.—ALIAMET.—An illustrated description of a portable universal galvanometer of Siemens & Halske.—*L'Elec.*, March 16.

Rheostat.—FRANKE.—An illustrated article on a new form of sliding rheostats for measuring purposes.—*Elek. Zeit.*, March 28.

Three-Phase Meters.—STERN.—An illustrated communication on the mathematical formulas for the energy of a three-phase system with three or four wires.—*Elek. Zeit.*, March 21.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Baudot System.—GRALLERT.—A very long and well illustrated paper read before the Electrotechnical Society, of Berlin, in which he describes in great detail the Baudot type printing apparatus for multiplex telegraphy.—*Elek. Zeit.*, March 28.

Telephony.—CANTER.—A brief illustrated article on the connection of telephone systems to Morse lines.—*Elek. Zeit.*, April 4.

Telephone Switchboard.—An illustrated description of the new switchboard of the Bell Telephone Company, at Buffalo, N. Y.—*Elec. Rev.*, April 20.

MISCELLANEOUS.

Electric Soldering of Zinc Pipes.—CALMEAU.—A description of a method in which the soldering iron is heated electrically. The usual copper portion of the soldering iron is surmounted by two sections or chambers one above the other, and insulated from one another by a partition of asbestos. The upper section carries a carbon pencil capable of being raised and lowered by means of a screw cut on its holder, and connected with the negative terminal of the source of the electric current, while the bottom of the lower section is formed by the copper portion of the soldering iron, which copper is connected with the positive terminal. The carbon pencil passes through the asbestos partition into the lower section, and being first brought into contact with a slight prominence on the copper and then slighly withdrawn, an electric arc is produced which heats the copper. The article is illustrated in detail.—*Ass. Ing. El. Liege, Bull.*, Aug. 14, 1900; abstracted in *Science Abstracts*, March.

REFERENCES.

Elektrotechnische Mitteilungen.—This is a new illustrated German monthly, edited by J. Zacharias, and published by W. Knapp in Halle. It is a journal not for electrical engineers, but for educated laymen who are interested in electricity. The January number contains the following articles: On the abolition of the accumulator traction on the Berlin tramways; what is electricity? on electric meters; rules for making a galvanic battery; the electric incandescent lamp; on electric clocks; danger of fire from electric installations; the joining of the tramway rails; lightning-rods; an electric launch. The February number contains an illustrated article on the question: What is magnetism? two illustrated articles by Ruhmer, on the Slaby-Arco system of wireless telegraphy, and on acoustic phenomena of the electric arc; an illustrated description of several new electric meters; also shorter articles on the storage battery, electricity on main lines, etc.—*Elek. Mit.*, Jan., Feb.

Electrical Laboratory.—STEINTHAL.—An illustrated description of the electrical equipment of the new physical laboratories of Owens College, Manchester.—Lond. *Elec. Rev.*, April 12.

Artificial Carbon.—ZELLNER.—A review of the historical development and the present conditions of the manufacture of artificial carbon, with many references to original patents and articles.—*Zeit. f. Elektrochemie*, March 28.

Manufacturing Plant.—An illustrated description of Nalder Bros. and Thompson's Dalston works, where parts of instruments and complete switchboards and circuit breakers are made.—Lond. *Elec. Rev.*, March 29.

Manufacturing Plant.—An illustrated description of the works of the Eddy Elec. Man. Co.—*Elec. Rev.*, April 13.

Paris Exposition.—JOVIGNOT.—A very long and well illustrated paper read before the Int. Soc. of Elec. in Paris on the moving platform of the last Exposition.—*Bull. de la Soc. Int. des Elec.*, Jan.

KORDA.—An illustrated description of three-phase alternators of Brown, Boveri & Co.—*Elek. Zeit.*, April 4.

A continuation of the illustrated serial. This part deals with several measuring instruments.—Lond. *Elec.*, April 12.

New Books.

AMERICAN STREET RAILWAY INVESTMENTS, 1901. Cloth. Large quarto. 288 and xxxiv. pages, 29 maps. Street Railway Publishing Company: New York City. Price, $5.

This valuable and interesting compilation of the street railway statistics of America once more makes it appearance, to find its way to the desk of every one interested in the financial development of street railways, whether bankers, brokers and capitalists, or those who operate the systems. The book is unique in the fact that it gives details with regard to the district in which each street railway is situated, and furnishes a vast amount of information as to the capital stock, funded debt, receipts, expenses and balance sheet of almost every system in the country. In addition to this the names and positions of the officers of each road are given and a large variety of information as to the physical equipment of the system is presented, together with the date at which the report was made. This data is not thrown down in a confused mass, but is carefully and systematically arranged, and one can quickly arrive, from consulting it, at a fair idea of the value of any street railway security, as well as the extent to which the system subserves the transportation necessities of the locality in which it operates.

In addition to the 300 pages of information of this character, the work is prefixed by some valuable comparisons of no fewer than 224 of the street railway properties included in the work. These properties are included in five different groups on the basis of their gross receipts, and then the figures are given for each road, comparing 1900 with the preceding year. It is encouraging to see that throughout these systems a general high average of increase was reported. In one of the groups the average of increase for 1900 was not less than 21.83 per cent, whereas the average increase in 1899 was but 10.2 per cent. The study of this as well as of the whole volume strengthens the conviction that the street railway developments of the country are, as a whole, being carefully and conservatively managed and are constantly rising in the scale of staple, permanent investments. We can heartily commend this manual to all of our readers who make a study of industrial and financial topics, and especially to those who are interested in ascertaining the capabilities of street railway properties.

BOOKS RECEIVED.

TELEPHONE LINES AND THEIR PROPERTIES.—By William J. Hopkins. Revised and enlarged. New York and London: Longmans, Green & Co. 307 pages, illustrated. Price, $1.50.

ELEMENTARY QUESTIONS IN ELECTRICITY AND MAGNETISM. By Magnus Maclean, D. Sc., M. I. E. E., and E. W. Marchant, D. Sc., A. I. E. E. London and New York: Longmans, Green & Co. 59 pages. Price, 35 cents.

INVENTOR'S MANUAL. How to Work a Patent to Make it Pay. Revised and enlarged edition. New York: Norman W. Henley & Co. 115 pages. Price, $1.

An English Electrical Instrument and Switchboard Factory.

Our London correspondent sends the following account of a recent visit to the Dalston works of Nalder Brothers & Thompson, which company, owing to the rapid progress of its business, had to establish works at Kingsland Green, Dalston, in addition to the factory at 34 Queen Street. These works are devoted to the manufacture of the parts of instruments and complete switchboards and circuit breakers. The assembling of instruments and testing of same is still carried on at Queen Street, as previously.

The ground floor of these works, in which we noticed at the entrance a Rochester time recorder, is devoted first to stores and time-keeping departments, the engine room and dynamo room, the dynamo being provided for the purpose of lighting the works as well as for furnishing current for motors instead of relying on long-belting transmissions for the upper floors. In addition to this the painting shop and lacquering shop are here, both of which have the very best of light, and in this respect we must say the whole of the works is exceptionally good. In the erecting shop on the ground floor for the larger class of switchboards the illustration shows a portion of the Luton central station board. This erecting shop is fitted with all the most modern tools for slate drilling and for dealing with large bus-bars, a number of which for another important station board are seen in the foreground.

On the first floor the machine shop proper is situated. One view shows the west side, which is devoted almost entirely to milling machines. On the east side, of which there is also a view, the turret and engine lathes are situated. The drilling machines are placed in the middle of the shop, and as far as possible all machines of a kind are grouped together.

The suds and oil for the whole of the machinery on this floor is supplied to each individual machine from a tank situated at the top of the building, all the lubricant running from the machines into open troughs placed below the floor whence it runs into another tank, out of which it is continually pumped to the upper tank, already referred to. Nearly the whole of the work carried out on this floor is done systematically to special jigs and fixtures. We noticed, we may mention in passing, that many of the tools here were of American make, and the system of keeping the shop in a cleanly condition as well as the heating by suspended steam pipes is in accordance with the practice now more generally obtaining. At the far end of the shop a tool room is situated. In this shop the tools are not only stored for serving out, but all operations for fitting in connection with them are carried through here. In addition to the lathes for particular work in this shop, a gas furnace is provided for hardening and tempering the more delicate tools. The blower which serves this also furnishes compressed air to the various blow pipes throughout the building.

Adjacent to the tool room is the grinding room, which is provided with Brown & Sharp's universal grinding machine, surface grinding machine, Cincinnati universal cutter grinder and a Washburn twist drill grinding machine.

On the second floor the assembling of switches and circuit breakers and small parts is generally carried out. This is provided with numerous lathes and drilling machines in the body of the shop and also an engraving machine which is observed in the foreground illustration. All around are arranged benches with vices. In addition on this floor all finished work is taken into store.

The third floor is devoted also to fitting and assembling work, and large switchboards are erected here, as there is plenty of head room and splendid light. This is more easily accomplished insomuch

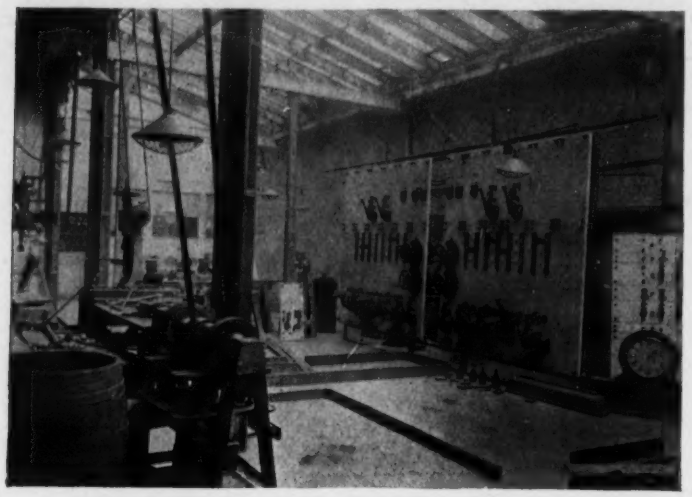


FIG. 1.—ERECTING SHOP.

FIG. 3.—ASSEMBLING ROOMS, LATHES AND DRILLING MACHINES.

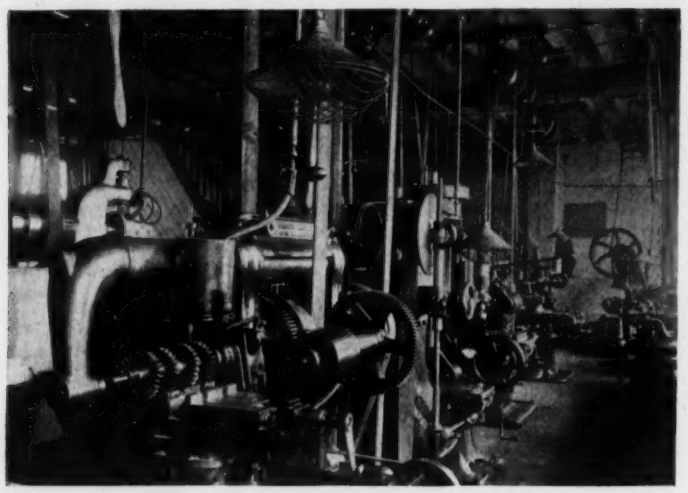


FIG. 2.—MILLING MACHINES.

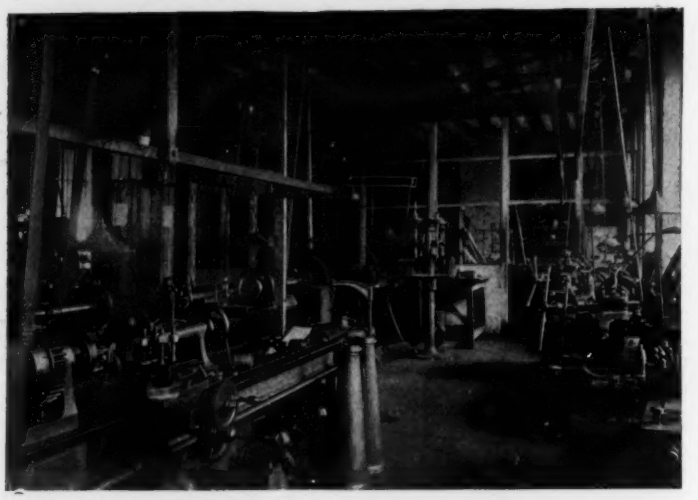


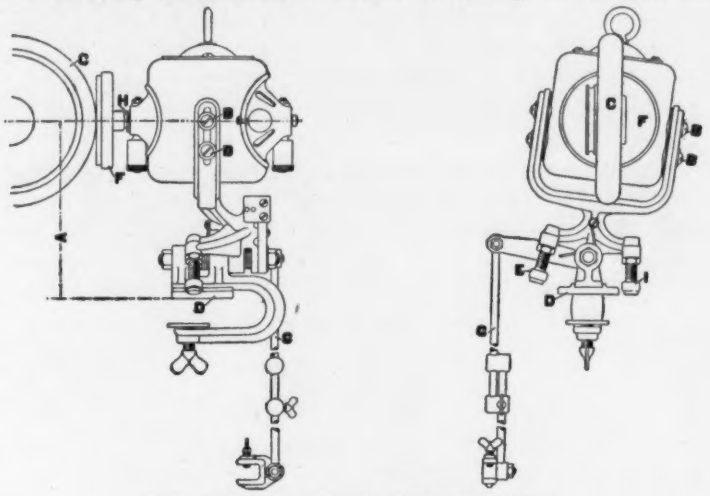
FIG. 4.—TURRET AND ENGINE LATHES.

VIEWS OF ENGLISH ELECTRICAL INSTRUMENT AND SWITCHBOARD FACTORY.

that in the middle of the building a power operated elevator is provided which passes from the bottom of the building to the top. Ample bench and vice accommodation is also provided. At the time of passing through the shops we saw a considerable amount of heavy switchwork and quantities of parts going through for general stock.

Sewing Machine Motor.

The accompanying illustrations show a method of operating sewing machines by means of electric motors. This method possesses the following characteristics: Absence of belting, no rheostat, the



FIGS. 1 AND 2.—SEWING MACHINE MOTOR.

transmitters can be applied to any machine without special fitting, the motor runs only when the sewing machine is in operation and takes power in proportion to the amount of work being done, the

FIG. 3.—MOTOR ATTACHED TO SEWING MACHINE.

speed, which is variable, is under the control of the operator, and the range of the operation of the machine is from two stitches per minute up to 2000. The machine head is driven positively at all times, and the variable speed is obtained by means of a variable leverage, so that any degree of work, no matter how heavy, may be accomplished by allowing the machine head to operate at a sufficiently low speed.

These transmitters are at present made in two sizes, for both alternating and direct current. The No. 1 size is for household work, and the No. 2 for factory work. They are manufactured by the Paragon Fan & Motor Company, 572 First Avenue, New York. Figs. 1 and 2 give different views of the transmitter, and Fig. 3 shows a transmitter attached to a sewing machine.

Steel Conduits and Fittings.

The two illustrations herewith represent (Fig. 1) a water-tight switch, and (Fig. 2) an enameled screwed steel conduit, manufactured by the Simplex Steel Conduit Company, Coventry Street, Birmingham, England.

The Simplex steel conduit system for the interior wiring of electric light and power installations consists of a combination of enameled or galvanized steel tubes and malleable cast iron fittings and accessories. The conduits or tubes are made in four grades, viz.: Enameled steel conduits, enameled brazed steel conduits, galvanized steel conduits and enameled screwed conduits. The first three grades are made in light gauze steel for socket-jointing, and the fourth is a heavy gauge conduit for screwed junctions. In each of these grades the conduits are made in eight sizes, having external diameters, ranging from ½ inch to 2 inches.

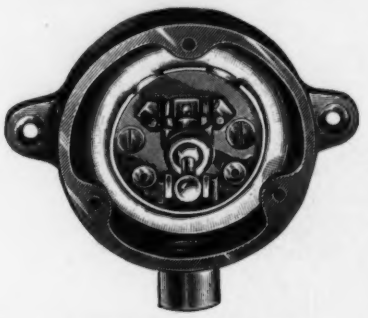


FIG. 1.—WATER-TIGHT SWITCH.

The advantages claimed for this conduit are high economy in first cost, installation cost and maintenance; mechanical strength combined with lightness and durability; electrical efficiency; neatness, compactness and accessibility. It is said to be suitable for all conditions of wiring work, except in exceptionally damp situations.

The Simplex enameled screwed steel conduits being screwed are made from considerably heavier gauge strip than the other grades, and therefore they are much stronger. They are suitable for special work where there is a likelihood of their being roughly handled or damaged, as, for instance, in the holds of steamships, in breweries, railway stations, car sheds, inspection pits, engine rooms, etc. The conduit is made for use with screwed fittings, and is particularly

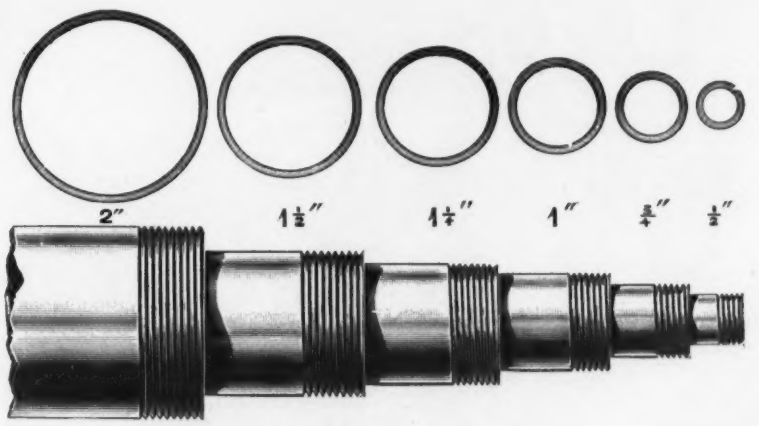


FIG. 2.—ENAMELED STEEL CONDUIT.

adapted for electrical purposes, on account of its smooth interior. In the Simplex system there are upwards of 400 fittings and accessories. These are applicable to each class of conduit, and have been designed with the primary object of efficiency combined with economy.

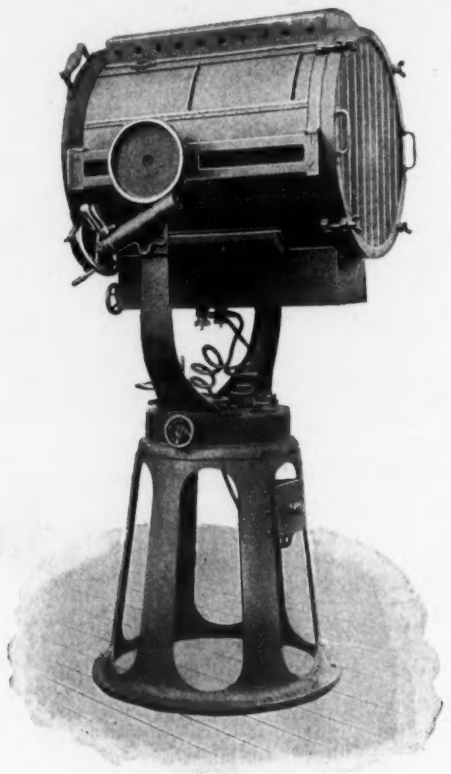
The switch illustrated has been specially introduced for use in conjunction with the Simplex emigrant, corridor and subway fittings. The box of the switch has been designed to take and can be fitted with any of the ordinary tumbler or turn switches in general

use. The cover and the nipple are fitted with rubber rings, and the bottom of the porcelain is kept about 3/8 inch off the base of the box to allow for the wiring connections, which can be made before the switch is screwed down.

Searchlights for the Navy.

We have from time to time described the various types of searchlight projectors used in the United States Navy, and in this issue we show an illustration of a type of hand-controlled projector which is being furnished to a number of the new destroyers and cruisers, by the Carlisle & Finch Company, of Cincinnati. The accompanying illustration shows an 18-inch projector, but the 24-inch and 30-inch projectors of the same manufacturers are identical in construction except that they are, of course, larger and heavier.

The specifications of the navy require a much better projector than is necessary for ordinary commercial use. In the first place, no iron or steel is used in the construction unless absolutely necessary, such as magnet cores, etc., where no other material would answer. The carbon feeding mechanism must be capable of working in any position, and to feed the carbons the entire length without any apparent difference in the voltage across the arc. The cylinder or the barrel of the projector must be capable of rapid rotation by hand or gradual



SEARCHLIGHT.

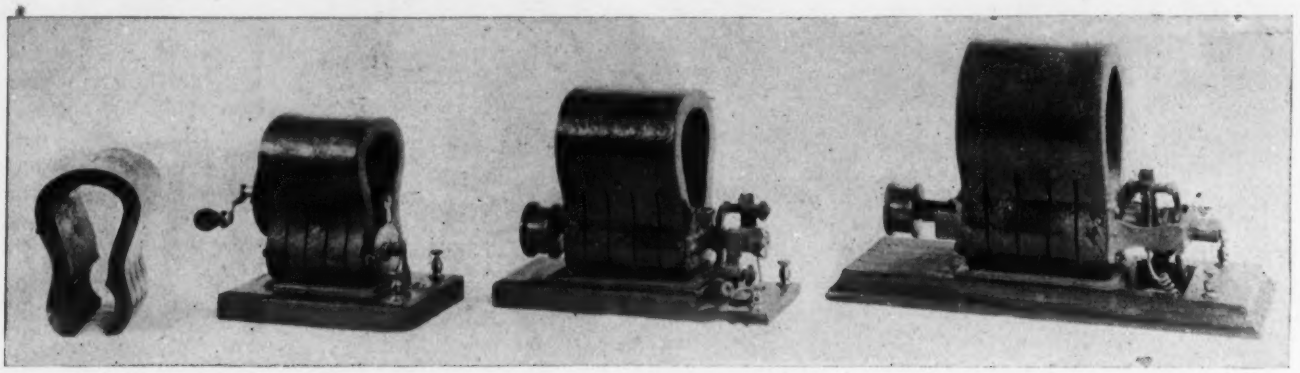
rotation by means of gearing. A vertical elevation of 70 degs. above the horizontal, and 30 degs. below the horizontal is required; added to these requirements, the entire projector must be constructed in the best possible manner and be absolutly reliable in its every part.

The projector shown is required to pick out a white object 10 ft. by 20 ft. at a distance of 4000 yards, and the larger projectors at distances of 5000 and 6000, respectively. Parabolic mirrors or Mangin mirrors may be used, and the projector is so constructed that either can be inserted in a few minutes. In case of an attack by torpedo boats, the light would be used at close range, and is required to cover as great an area as possible. To do this, a special front cover is supplied, which is fitted with a set of dispersion lenses. These lenses spread the light out horizontally, but not vertically, so that the water is illuminated for a wide range.

The mechanism for transmitting vertical motion to the cylinder consists of a worm and worm wheel which may be thrown in or out of mesh like the back gear of a lathe. The trunnions for supporting the cylinder are adjustable.

Magnetos for Special Work.

The field for the use of magnetos so far from diminishing seems to be decidedly on the increase, and considerable ingenuity is therefore being spent on their improvement. Among those who have devoted their attention to this specialty is Mr. John E. Fuller, P. O. Box 237, Brooklyn, N. Y., who has taken out several patents on the subject during the last few years, and whose principle of slotting the magnet frame is illustrated herewith in Figs. 1, 2, 3 and 4. The magnets are cast in one piece, as shown in Fig. 1, and then cored and slotted, this constituting, it is said, a notable economy in manufacture. Fig. 2, here shown, is a gas engine spark igniter, which will give a full bright spark of 1 to 1½ inches at medium speed. Fig. 3 is a similar type of machine. Fig. 4 is a generator intended for telephone work, and will, it is stated, ring through 100,000 ohms resistance. The armature carries an automatic switch which cuts out the armature wire and switches in the line wire, instantaneously, when the user has finished ringing. It is interesting to note that Mr. Fuller has been experimenting on types of these machines for bicycle lamp purposes. In this case the generator weighs about 1 lb., giving a brilliant light at low speed, and at high speed cutting in a resistance which protects the little lamp from burning out, a trouble experienced hitherto in this class of work.

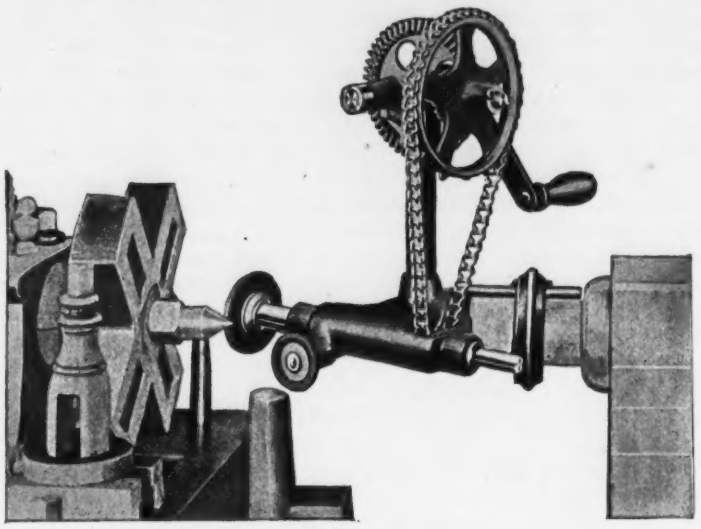


FIGS. 1, 2, 3 AND 4.—MAGNETO GENERATORS.

Lathe Centre Grinder.

The lathe centre grinder illustrated herewith is manufactured by L. S. Heald & Son, Barre, Mass. It is designed to be sold at a low price, and to have its work just as effective as that of more complicated machines in which the wheel is driven by power obtained either from the face plate of the lathe, or from a friction roll running on the largest step of the cone. This grinder is clamped directly on the tail spindle and carries a grinding wheel at such an angle that it will grind the center to the angle of 60 degs. without possibility of error and without any delay from the cut and try method of setting up. It does not matter what the size of the tail spindle is, or whether the lathe happens to have on a large or small face plate or any face plate at all; and as it uses hand power there are no connections to make to get power. It does not matter either whether the tail stock happens to be set over for turning tapers or not, as the correct angle will be given the center just the same. The grinding spindle is driven by sprocket wheels and chain, making it easy to get plenty of speed for the wheel, and this construction makes a

very easy running machine without the bother of slipping belts or the noise of several gears.



LATHE CENTRE GRINDER.

The sliding bearings are separate from the rotary bearings, so there is none of the lapping out process that ruins many machines of this kind. The rotary bearings are never uncovered, and therefore the entrance of grit is wholly prevented. The particular advantages of this machine are its simplicity and ease of setting up.

Static Ground Detectors.

In many switchboard installations a very convenient and efficient piece of apparatus has been omitted on account of the danger to switchboard attendants accompanying its use. The instrument in question is the ground detector, and in some instances, while they have been provided, they have been located in some obscure and seldom frequented place because of the noted disadvantage. Another characteristic defect of the early type of ground detectors was the necessity of first introducing a temporary ground occasioning increased danger to linemen and the possibility of short circuiting the system.

The S. K. C. high-voltage ground detector herewith illustrated and described is designed and said to be the first instrument to combine thorough reliability at all times with absolute immunity for switchboard attendants from danger of shock. It is especially adapted

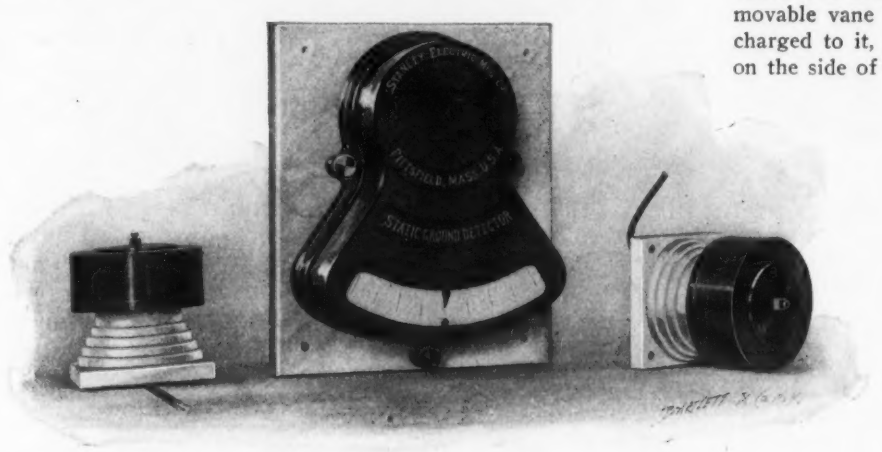


FIG. 1.—HIGH-VOLTAGE GROUND DETECTOR.

for high voltages and use on single-phase, two-phase 4-wire and three-phase 3-wire circuits.

The instrument case is entirely of hard rubber, molded to the required form. Inside the case, four fixed vanes are arranged around a movable vane, as in Fig. 2. The movable vane is made of aluminum, is carried on jeweled bearings and attached to the pointer. The fixed vanes are connected diagonally in pairs, and each pair is charged statically by one of the line wires through the medium of a condenser. The condensers are independent of the instrument and generally mounted behind the switchboard, as in Fig. 2. The instrument has three binding posts, from which connection studs extend back and serve to support it on the marble. The binding posts at the sides each connect a pair of the fixed vanes with the secondary of one of the condensers. The lower binding post serves to connect the movable vane to the earth. The connection studs serving jointly as back connections and as supports, minimize the labor required for installing and removing from the switchboard. The number of holes required in the marble is also minimized.

The movable vane is acted upon inductively by the fixed vanes, so that the stress produced by each pair is equal, but opposite. The

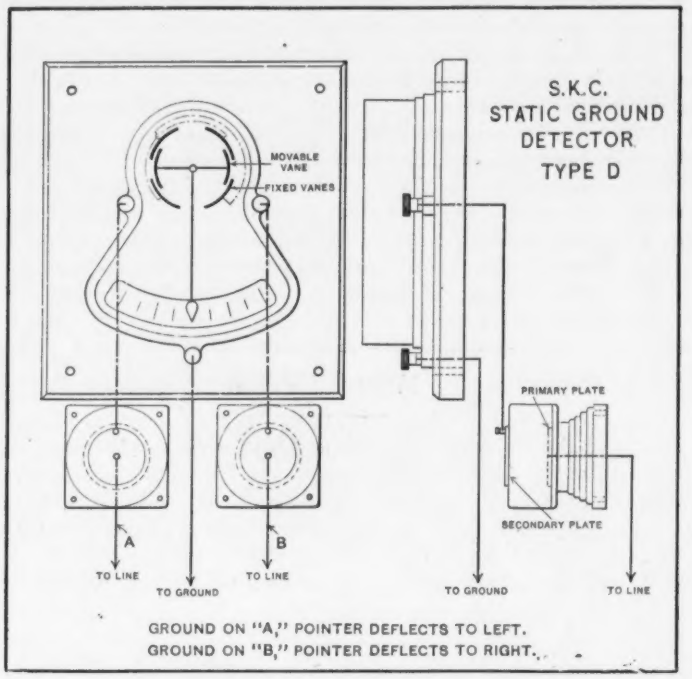


FIG. 2.—DIAGRAM OF GROUND DETECTOR.

movable vane, in consequence, takes a position equally between the fixed vanes. This position is the same whether the instrument is charged or not, and the pointer stays at zero, indicating no ground.

If, however, the primary plate of one of the condensers and the movable vane become electrically connected, as happens in the event of a ground, immediately the pair of fixed vanes, which lead to that condenser, assume with the movable vane a like polarity, and the latter is repelled. At the same time the action of the other fixed vanes is to attract. The two forces acting in the same direction, the movable vane takes a position entirely within the vanes oppositely charged to it, and the pointer takes a position indicating a ground on the side of its deflection. Absorbing no energy in operation, the

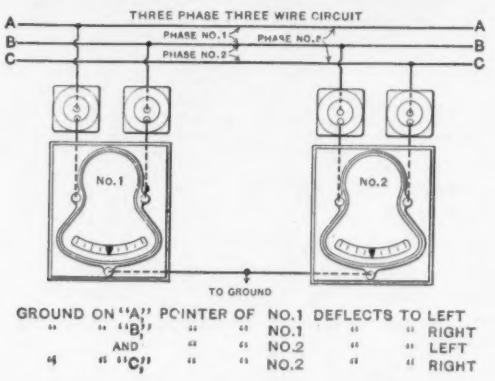


FIG. 3.—DIAGRAM OF CONNECTIONS.

instrument is kept permanently connected, and ofttimes an instrument on each circuit, may be used advantageously.

The two condensers which are used with each instrument are made as follows: The primary plate, which is connected to the line, is entirely imbedded in a hard rubber block. On top of this hard rubber block is placed the secondary plate, which is connected to the fixed vanes of the instrument. Each rubber block is then mounted on a large procelain insulator.

Instruments for different potentials are exactly alike, the adjustments for the different voltages being made in the condensers. Fig. 1 shows the general appearance of the S. K. C. ground detector and its separate condensers for 20,000 volts.

The use of separate condensers for charging the fixed vanes keeps all high potentials out of and away from the instrument, and as the instrument case is made entirely of hard rubber, the insulation is perfect. The use of separate condensers also has the advantage of allowing the instrument to be mounted wherever convenient, without regard to the location of the line wire. All that is necessary is to connect the secondary plates to the fixed vanes of the instrument by means of fine wires. The condensers can be located at or near the line wires, and insulated from each other by as great a distance as is thought necessary.

The dielectric of the condensers being hard rubber and having the primary plate imbedded in it, there is absolutely no danger of a lightning discharge going to "earth" through the instrument; in fact, there is never any connection in the instrument between the line wires or between either of the line wires and the ground.

The instrument is entirely automatic in its action indicating grounds when they occur, and returning to the zero position when they are removed. Fig. 2 shows the instrument and its condensers connected to a single-phase circuit, and Fig. 3 represents the connections for a three-phase three-wire circuit, two instruments and four condensers being used.

A Bisulphate of Mercury Primary Battery.

Now that the spring has arrived, and that warmer weather is beginning to make itself felt, the demand for fan motors arises once again, and more extensive preparations than ever are being made to meet it. It happens, however, and this condition will probably continue for a long time to come, that a large proportion of the inquiries and applications come from people who are not reached by electric circuits, and the result is that their wants have to be met if possible by some form of storage or primary battery. The storage battery is in many respects handy, but facilities for recharging are necessary; and still, all too frequently, these do not exist. There thus remain, not only throughout this country but in various parts of the world, particularly the tropics, large regions where the fan motor is highly appreciated, but can only be enjoyed through the intervention of some primary battery. It has been the aim of inventors for some time past to furnish a cell that would answer all the requirements of such work. One of the most interesting types of this character is that which has recently been put on the market by the Hussey Dynamo Battery Company, of 39 Cortlandt Street, New York City. This cell, which is the invention of Mr. Charles A. Hussey, who has been actively engaged in the improvement of primary batteries for at least a quarter of a century past, has been named by him the "Hussey dynamo battery" on account of its large amperage and the general ease with which it can be handled. The aim of the inventor was to produce a battery in which the oxidizing agent in the form of a salt could be gradually renewed as it is used up, without trouble, so that the cell would not be liable to polarize. In this cell Mr. Hussey employs bisulphate of mercury, and the battery is built up in the tubular form indicated by the accompanying cuts, which show also the outer special containing jar and the cell complete. The jar, of course, may be of glass or rubber, and the elements, zinc and carbon, are made in annular form as shown, thus presenting a very large surface to the action of the electrolyte. The upper connector of metal parts shown resting on the rim of the flanged battery carbon are of aluminum, which is not attacked by the mercury bisulphate. As will be noted, the lower end of the carbon is made with an inner flange, giving it somewhat of a cup form, thus enabling it to hold the porous cup, which has an outer flange extending outwardly and resting on the carbon flange, without, however, constituting a liquid-tight joint. In the porous cup placed within the carbon is suspended the circular zinc, which, as will be noted, is made in two portions, an upper and a lower ring connected by bars or straps. When the battery is assembled the porous cup is inserted into the cylindrical carbon so as to rest on the internal flange, as stated above. The annular space between the carbon and the porous cup is then filled with the bisulphate of mercury up to the flaring portion of the carbon indicated in one of the cuts. When this has been done, the carbon and the cup are inserted into the glass jar. The glass jar is then filled through the hole in the top of the zinc with nothing but plain water, until the water reaches within one inch of the top of the glass jar.

In the operation of the battery the mercury bisulphate is decomposed so as to set free sulphuric acid, while the oxygen given off unites with the nascent hydrogen liberated from the zinc, forming water. The metallic mercury being precipitated and passing between the carbon and the porous cylinder, at the bottom, collects on the floor of the containing jar. Salts of zinc are formed also by the action of the battery, and these are gradually dissolved in the exciting solution. The renewal of the oxidizing bisulphate of mercury is accomplished by inserting another supply through the flare or wide funnel-shaped opening in the carbon, and thus a great advantage is secured in being able to renew or recharge the battery and maintain a constant current without dismounting it or taking out the parts or suspending work. As those who are familiar with handling primary batteries are aware, there is often considerable annoyance and trouble in renewing primary batteries, and one of the reasons they are not in more frequent use for heavy work is the bother and expense which often attends this operation.

FIGS. 1, 2, 3 AND 4.—BISULPHATE OF MERCURY BATTERY.

When the exciting solution has become unduly saturated with the salts of the zinc the nozzle of a syringe can be inserted into the cup through the hole in the top of the zinc, and the saturated solution taken off. The metallic mercury which has collected by gravity at the bottom of the jar can also be removed from time to time, and having a value may probably be worth while to collect. Water is then supplied to the porous cup, or such other renewal of the solution may be made as it is the practice of the user to employ.

Drawing upon the fund of experience given him by years of study in this field, Mr. Hussey has not only produced a battery for which he claims unusual cleanliness, economy, efficiency, simplicity and easy operation, but he has put it together in such handy shape as to render it convenient for use in running fans. For this work he uses the larger size, the jar being 8 inches high and 7 inches across the top of the flange. With two of these batteries in series any fairly well constructed fan motor taking from 10 to 15 watts will send a breeze across any dining table, sittingroom or bedroom. When the battery is not in use it has very little local action and maintains its internal

resistance and e. m. f. substantially unimpaired, while the fact that it does not have to be separated and then reassembled for further renewal makes it a very convenient form. The company will supply complete fan motor outfits with all the necessary adjuncts neatly put together, or will furnish the single cells, through its agents in various parts of the country. Mr. Hussey has also worked out the same form of battery for use in telephone work, for which it appears to have many advantages, and the company is already experiencing a large call in this direction. The voltage of the cell is 1½, and from tests which have been made it would appear that the small charges of the bisulphate of mercury, which comes in neat packages, will drive the fan continuously at a constant speed if the bisulphate of mercury is supplied as fast as it lowers in the space between the porous cup and carbon, on the same principle as a self-feeding stove.

It may be added that in addition to operating fan motors, telephone circuits, etc., Mr. Hussey is putting out these batteries for gas engine work, for jewelers' light work, dental operations, etc., and will be glad to receive inquiries as to its application.

An Automatic Telephone Meter.

The measured rate is undoubtedly one of importance to all interested in telephone matters, and the telephone company standing as it does in a position between the subscriber and the investor and being expected to satisfy both, very naturally welcomes inventions calculated to produce these results. No subscriber could reasonably offer objections to a measured service, provided the scheme for keeping account of his calls is of a nature that appeals to him as accurate and free from complications. The present measured service adopted by some of the large companies has proved a decided success, but the system lacks the confidence that a scientific, automatic counting device would inspire in the average mind.

FIG. 1.—TELEPHONE METER.

Actual tests made in one of the large cities by a leading telephone company using the measured rate plan show that a very large percentage of the connections made are not recorded against the subscriber as they should be. On the other hand, it is the usual experience of the telephone managers who have adopted the measured rate to have a large number of their bills contested by subscribers who feel that they have been charged for more connections than they actually use; therefore, while a measured rate plan is admitted by all to be the fairest method of charging for telephone service the difficulties of keeping such a record are great and have prevented its natural development.

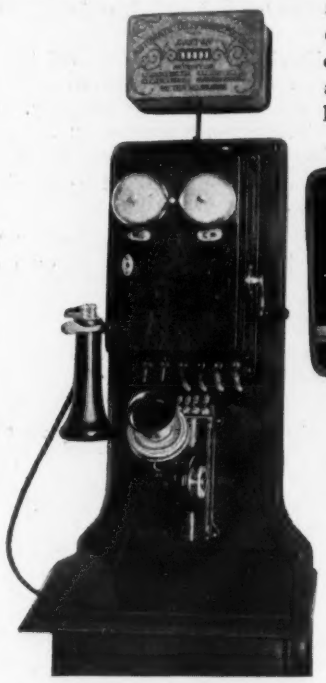


FIG. 2.—METER ATTACHED TO TELEPHONE.

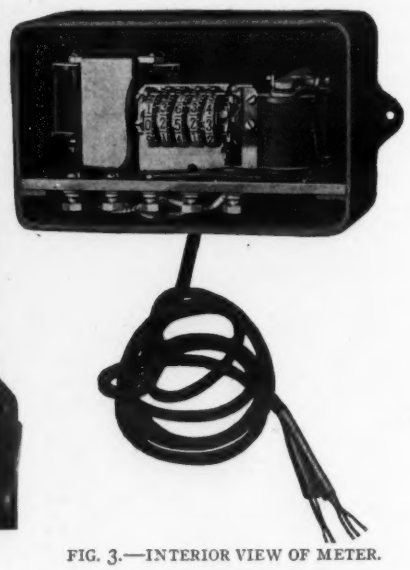


FIG. 3.—INTERIOR VIEW OF METER.

The Automatic Telephone Meter Company, of Boston, Mass., has gotten out an instrument for automatically recording telephone connections. The instrument, Fig. 1, is placed at the subscribers station, the readings being in clear view of the subscriber at all times. The size of the meter is 4 by 6 inches, and it is quite ornamental in appearance. In operation no additional movement is made by the subscriber or the exchange operator, yet this meter records exclusively outgoing calls and then only on completion of a connection. It operates equally well on both the central energy and magneto call systems and the company claims that while it depends upon the joint movements of the subscriber and operator it is impossible for either one to influence its action by any means short of injury to the apparatus. The instruments can be used on party lines with equal advantage. Fig. 2 shows the method of attaching the instrument to a telephone.

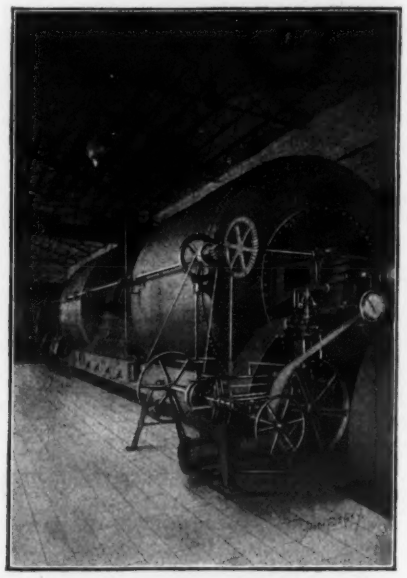
An interior view of the meter is shown in Fig. 3. The coils at the right belong to a selective device which discriminates between outgoing and incoming calls. The coils at the left operate a simple counter, which locks automatically and operates only once for each connection actually secured.

This metering system appears to be rendered complete by the time element being included in its sphere of usefulness, and when it is arranged to charge by actual time of conversation instead of number of conversations, the counter operates at a certain pre-determined speed, so long as the conversation is continued.

Every detail of the instrument has, it is stated, been thoroughly worked out and tested under actual working conditions, and in its present state it seems to meet every requirement of modern telephone service. The claims made for it may be briefly summed up as follows. 1st, it will record accurately and positively each conversation actually secured by the calling subscriber, and it is impossible for it to register an in-coming call; 2d, it is automatic and will register only when the usual movements of the calling subscriber, the operator and the called subscriber have been performed; 3d, there is no impedance to conversation whether the meter be used as a connection counter or as a time register, and no additional complication or rearrangement of circuits is necessary at the switchboard or subscriber's station; 4th, as there are no springs, clockwork or local battery required, the expense of maintenance and inspection is trifling, and, 5th, it is equally well adapted for the magneto, central energy and party line systems without change in design or adjustment.

Turbines in Mining Plant.

The illustration herewith represents two single horizontal-shaft, 54-inch McCormick wheels in an iron case discharging into a cast-iron draft chest. These turbines are operating in the power plant of the Boston & Montana Consolidated Copper & Silver Mining Company, Great Falls, Mont., and develop 2800 horse-power. The power is used for driving a generator and air compressor. The speed is regulated by a Lombard waterwheel governor.



HORIZONTAL SHAFT TURBINES.

This is said to be the heaviest pair of waterwheels ever built in America. The weight of the outfit is 280,000 lbs., not including power connections, pipes or draft tubes. These turbines were made by the S. Morgan Smith Company, York, Pa.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was in good demand, with fair supply. Rates were 4 per cent for 90 days and 4½ per cent for longer periods. Mercantile paper was quiet and supply limited. Rates, 4 per cent for 60 to 90 days' indorsed bills receivable, 4@4½ for choice four to six months' single names and 5@6 for others. In the stock market the activity continued on an enormous scale during last week. Early in the week irregularity with some heavy selling and declines prevailed, due to the gold shipments caused by the large subscriptions here aggregating $150,000,000 to the new British war loan. From the speculative standpoint the situation was the most interesting which the bull market has yet exhibited. On Tuesday the dealings in stocks aggregated nearly 2,400,000 shares, which surpassed all previous records. United States steel stocks were at one time weak in the face of the strength in other quarters, the common falling to 45½ and the preferred to 93½. There was a sharp rally, however, in both these securities on the advance of steel rail quotations and on the statement showing the company's very large surplus over charges for March. During the present week, the Exchange, having moved to temporary quarters in the Produce Exchange for one year, while its own home is rebuilt, celebrated the change of base by dealing in nearly three million shares on Monday, and by breaking other records in every direction as to prices, single orders, rise in quotations, etc. There were no marked features last week in traction or electric stocks, and with the exception of Brooklyn Rapid Transit, trading was about normal in the entire list. Metropolitan Street Railway closed with a net loss of 1⅛ points, the sales for the week aggregating 111,100 shares. The sales of Brooklyn Rapid Transit reached 269,000 shares, and the stock closed with a net loss of 1½ points. General Electric made a net gain of 1½ points, the sales aggregating 3206 shares. Western Union was quiet, the sales amounting to 17,600, the stock closing with a net gain of ¼ of a point. Following are the closing quotations at the four exchanges named:

NEW YORK.

	Apr. 20.	Apr. 27.		Apr. 20.	Apr. 27.
General Electric	223½	225	Electric Vehicle	12	—
Brooklyn Rapid Transit	86¾	85¼	Electric Vehicle, pfd	20	—
Metropolitan Street Ry	174	172⅜	General Carriage	2½	—
American Tel. & Cable	100	—	Illinois Elec. Veh. Tran.	⅞	—
Western Union Tel	93¼	93½	Hudson River Tel.	—	—
American Dist. Tel	—	35	N. E. Elec. Veh. Tran.	2½	—
Commercial Cable	179	180½	N. Y. Elec. Veh. Tran.	4½	—
Electric Boat	17	—	Tel. & Tel. Co. of Am.	5	—
Electric Boat, pfd.	47	—	N. Y. & N. J. Tel.	—	—
Electric Lead Reduc'n	4½	4⅝			

BOSTON.

	Apr. 20.	Apr. 27.		Apr. 20.	Apr. 27.
New England Telephone.	—	—	Erie Telephone	60	61
Mexican Telephone	3	3	General Electric, pfd.	—	—
Westinghouse Electric	—	—	Am. Tel. & Tel.	176½	176
Westinghouse Elec., pfd.	—	75½	Boston Electric Light	—	—

PHILADELPHIA.

	Apr. 20.	Apr. 27.		Apr. 20.	Apr. 27.
Electric Storage Battery.	69¾	69	Philadelphia Electric	6⅜	6½
Elec. Storage Bat., pfd.	74	74	Pa. Electric Vehicle	1¼	1⅜
Elec. Co. of America	9⅛	9⅛	Pa. Elec. Veh. pfd.	1	1⅜
General Electric Auto	—	—	Am. Railways	42¼	44½

CHICAGO.

	Apr. 20.	Apr. 27.		Apr. 20.	Apr. 27.
Chicago Edison	155	—	Chicago Telep. Co.	—	—
Chicago City Ry.	—	—	Union Traction	—	—
National Carbon	—	15¾	Union Traction, pfd.	—	—
National Carbon, pfd.	—	85	Northwest Elev. Com.	—	38

*Asked.

THE VAN CHOATE SWINDLE.—A special dispatch from Boston, of April 25, says: The inside history of an enterprise which cost the poor people of New England millions in the aggregate, and of which there is scarcely an asset left, is given in the report filed today of Stephen H. Tyng, appointed by the United States Circuit Court Auditor in the case of W. L. Clark vs. the Van Choate Electric Company, to pass upon claims presented by creditors of the company. Mr. Tyng says that when the company was organized its only assets consisted of rights and property turned over by Van Choate for 599,900 shares of the stock received by him. "The actual, tangible property turned over," says the report, "was so inconsequential in amount and value as to be scarcely worthy of consideration, and that any sane person would pay $6,000,000 for what he turned over is simply preposterous." Mr. Tyng says Van Choate and his associates were perfectly conscious of the fact that the corporation was vastly overcapitalized. He finds that none of the inventions had been determined to be a practical commercial success, or really had any pecuniary value whatever, and that the company from its inception was in an insolvent condition.

ELECTRIC COMPANY OF AMERICA.—It is stated that during 1900 the Electric Company of America has received 70 propositions for the purchase of plants. Fifty of these were rejected and 20 were examined by the company's experts. The Bridgeport, Ohio, plant was purchased June 1. The company has a 10-year lighting contract there. The power is supplied from the Wheeling (W. Va.) works across the Ohio River. The Rockford, Ill., property was purchased Nov. 1. It is reported as having a good steam and water power business. Power is supplied to the Rockford Railway, Lighting & Power Company and to the Interurban Company. Extensions are contemplated to both the Atlantic City and the Conshohocken plants. Franchises have already been obtained for South Atlantic, Ventnor and Longport, to be lighted from the Atlantic City station. The Atlantic City Gas & Water Company, in which the Electric Company of America has a large interest, has been moved to the Atlantic City Lighting Company plant. A franchise has been obtained for Spring Mills, which will be served from the Conshohocken plant.

AMERICAN TELEPHONE & TELEGRAPH.—Kidder, Peabody & Co. offer for subscription $2,500,000 American Telephone & Telegraph Company collateral trust 4 per cent bonds at 100½ and accrued interest. The bonds are included in the outstanding issue of $15,000,000 collateral trust 4 per cent bonds, under an indenture which permits the issue of $100,000,000 bonds. There are now outstanding $10,000,000 American Bell Telephone A 4s and $15,000,000 collateral trust 4s, a total of $25,000,000 4 per cent bonds. These bonds call for an annual interest disbursement of $1,000,000 per annum. The net revenue of the company for 1900, after deducting interest and taxes, amounted to $5,486,057. The cost of replacement of the company's assets, it is estimated, would be much more than the par value of the securities outstanding, and much could not be replaced.

THE UNITED TRACTION COMPANY, of Pittsburg, Pa., reports gross earnings for March of $157,792, an increase of $9,783 as compared with the same month of last year, and net $70,741, an increase of $5,230. For the nine months ending March 31 the gross earnings were $1,434,145, an increase of $112,987, as compared with the corresponding period of last year, and net $634,423, an increase of $30,269.

BAY COUNTIES POWER COMPANY.—It is understood that the Bay Counties Power Company, San Francisco, has given a second mortgage in the sum of $750,000, covering all of its property, to secure a bond issue to that amount. These bonds are to run for 30 years, and are at 6 per cent, payable semi-annually. They are redeemable at any time at 110. It is said that the greater part of the bonds has been placed in San Francisco.

DIVIDENDS.—The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1½ per cent on its assenting stock, payable May 15.

Commercial Intelligence.

THE WEEK IN TRADE.—General trade, according to reports to the mercantile agencies, manifested a strong underlying tone last week, which seemingly lacked only the advent of better weather to become buoyant. In some directions, activity is pronounced, as, for example, in iron and steel, where apparently production is taxed to its capacity, though apparently more to meet existing requirements than for new orders. Railway gross earnings continue to show substantial gains, the current receipts of the Southwestern lines being the best in their history, and Western and Southern roads are doing almost as well. The failures during the week as reported by *Bradstreet's*, numbered 214, as against 212 the week previous and 182 the same week a year ago. There was very little activity in copper, and no change in prices. The controlling interests still adhere to 17 cents for lake and 16⅝ cents for electrolytic. During the week the Government bought 300,000 lbs. of lake at 17 cents, delivered in Washington.

ENGINE BUILDERS' CONSOLIDATION.—A little more light is thrown this week on the engine builders' consolidation. It is now said that the new company will be known as the Allis-Chalmers Company. The E. P. Allis Company, of Milwaukee, the Frazer & Chalmers Company, of Chicago and London, the Gates Iron Company,

of Chicago, and the Dickson Manufacturing Company, of Scranton and Wilkesbarre, are the companies to be conducted under one management. The deal was consummated Saturday. It is understood that the locomotive works of the Dickson Company are to be operated as an entirely distinct concern for the present. In Philadelphia Mr. William L. Elkins, Jr., stated that the Allis-Chalmers Engine Building Company, had been formed with $12,500,000 preferred stock and $20,000,000 of common stock. Mr. Elkins said he had resigned from the presidency of the Pennyslvania Iron Works Company, which had not been taken into the combination. Mr. Elkins has also resigned as a director of the company. He is authority for the statement that large works will be built in the vicinity of Philadelphia, and the new concern when running full handed will employ about 15,000 men. Mr. Elkins is the only Philadelphia director of the new company.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York, for the week ended April 10: Antwerp—15 packages electrical material, $546; Argentine Republic—133 cases electrical material, $6,569; 3 cases motor vehicles, $1,850; 18 packages electrical machinery, $4,121. British Possessions in Africa—39 packages electrical material, $2,180. British East Indies—3 cases electrical material, $158. British West Indies—13 packages electrical material, $454. Bristol—6 packages electrical machinery, $2,030. Bolivia—9 packages electrical material, $160. Bremen—1 package electrical material, $75. Brazil—182 packages electrical material, $7,536; 50 packages electrical machinery, $36,667; 1 coil cable, $105. Cuba—3 packages electrical machinery, $57; 410 packages electrical material, $2,242; 1 reel cable, $137. Canada—20 cases electrical material, $180. Chili—1 case electrical material, $12. Central America—68 packages electrical material, $2,409; 1 case electrical machinery, $270. Dundee—5 packages electrical material, $520. Ecuador—82 packages electrical material, $1,476. Glasgow—1 case electrical machinery, $100. Hayti—9 packages electrical material, $149. Hamburg—28 packages electrical material, $2,142; 8 packages motor vehicles and parts, $5,000. Havre—7 packages electrical material, $100; 1 case motor vehicles, $600. Huddersfield—2 cases electrical material, $32. London—165 packages electrical material, $1,724; 32 packages electrical material, $1,668; 5 cases motor vehicles and parts, $3,820. Liverpool—175 packages electrical machinery, $20,375; 25 packages electrical material, $1,854; 5 packages motor trucks, $325. Marseilles—8 cases electrical material, $587. Mexico—66 packages electrical material, $1,368; 5 packages electrical material, $44. Newcastle—26 packages electrical machinery, $3,500; 1 package electrical material, $15. New Zealand—2 packages electrical material, $16. Peru—16 cases electrical material, $825. Preston—3 cases electrical material, $157. Ramsgate—2 cases electrical machinery, $200. Rotterdam—1 crate motor vehicles, $150. Siam—34 packages electrical material, $11,212. Southampton—7 packages electrical machinery, $1,300; 3 packages electrical material, $1,109; 6 cases motor vehicles, $3,000. United States of Colombia—4 packages electrical material, $113; 3 packages electrical machinery, $340. Venezuela—139 packages electrical material, $1,010; 1 package electrical machinery, $36. Vienna—16 packages electrical material, $792.

ORDERS FOR ELECTRIC HOISTS AND CRANES are reported as below by the Milwaukee firm of Pawling & Harnischfeger. They state that the outlook is very bright. They are receiving inquiries that indicate the influx of a large volume of new business. The recent sales are: American Sheet Steel Company, Wellsville Works, Ohio, one 30-ton, with 5-ton auxiliary hoist, and one 10-ton; Anheuser-Busch Brg. Assn., St. Louis, Mo., one 20-ton for power plant and one 5-ton for pumping station; American Clay Working Machinery Company, Bucyrus, Ohio, two 20-ton and one 15-ton; American Bridge Company, Philadelphia, Pa., one 8-ton for Post & McCord Branch, Brooklyn, one 25-ton and one 8-ton for Trenton branch; A. & P. Roberts Company, Pencoyd, Pa., one 25-ton, with 5-ton auxiliary hoist; Curtis Sheet Steel & Corrugating Company, Zanesville, Ohio, one 20-ton; Frankford Steel & Forging Company, Eddystone, Pa., one 10-ton; Oesterreichisch-Alpine Montangesellschaft, Vienna, Austria, one 5-ton; La Belle Iron Works, Steubenville, Ohio, three 5-ton, 100-ft. span, and two 5-ton, 80-ft. span; New York Shipbuilding Company, Camden, N. J., one 15-ton double trolley; Nordberg Manufacturing Company, Milwaukee, Wis., two 30-ton and two 10-ton; Philadelphia & Reading Railway Company, Pottsville, Pa., one 25-ton, with 5-ton auxiliary hoist, and one 30-ton double trolley; Puget Sound Naval Station, Bremerton, Wash., one 10-ton; Wheeling Steel & Iron Company, Wheeling, W. Va., two 10-ton; Sharon Steel Company, Sharon, Pa., one 5-ton; Parkersburg Steel & Iron Company, Parkersburg, W. Va., one 25-ton, with 5-ton auxiliary hoist; North Mount Lyell Copper Company, Crotty, Kelly's Basin, New Zealand, one 40-ton, with 5-ton auxiliary hoist; Laughlin Hall Company, Wheeling, W. Va., one 20-ton; Chandler & Taylor Company, Indianapolis, Ind., one 10-ton.

MACHINERY EXPOSITION AT FRANKFORT.—Consul-General Guenther writes from Frankfort, March 7, 1901: "On the 5th instant, a meeting, largely attended by the members of the technical and other societies, took place at Frankfort to receive the report of a committee charged with the duty of investigating the subject of a permanent exposition of machinery and models in this city. Plans for a suitable building and estimates of cost for the same were submitted; $50,000 was the estimated cost, but many thought the amount inadequate. After a long and animated discussion, the following motion was adopted unanimously: 'In view of the importance of Frankfort-on-the-Main as the center of a district rich in industries and commerce and of an immense passenger traffic, this meeting, called by the representatives of the Technical Society, the Frankfort branch of German engineers, the Electro-Technical Society, the Frankfort Society of Technical Engineers, the Society for Social Economy, the Agricultural Society, etc., deems a permanent exhibition of the trades and industries an urgent necessity and an efficient means to further the commerce, the industries, and the agricultural interests of Frankfort-on-the-Main. We therefore request the proper authorities and the general public to aid in its establishment.'"

W. R. BRIXEY, the well-known manufacturer of kerite cable, has just received notification from Washington, D. C., that he has secured the contract for supplying the submarine cable to be utilized for the purpose of connecting Juneau, the capital of Alaska, with Skagway, which is the southern terminus of the White Pass Railway. The contract will entail an expenditure in the neighborhood of $75,000. It is, apart from its monetary value, an important contract, as under existing circumstances Juneau is cut off from communication with the outside world, except by steamer from Seattle, from which point it takes four days to reach the far northern city. The cable, weighing about 600,000 lbs., will be shipped by rail from Seymour, Conn., to a point not yet determined on the Pacific Coast. From there it will be carried in a specially chartered steamer to Alaska. The line will be laid and in operation prior to Aug. 1, when it will be possible to telegraph Juneau from any cable office.

THE KAWASAKI DOCKYARDS, one of the principal undertakings of its kind in Japan, are about to place some more orders for American electrical equipment. The plant already consists of two 250-hp engines built by the Ball Engine Company, of Erie, Pa., which were purchased through the Frank M. Pierce Engineering Company, of New York City, and two 150-kw generators furnished by the Westinghouse Electric & Manufacturing Company. The dock authorities now call for a 500-hp Ball engine and a 500-kw Westinghouse generator.

WESTINGHOUSE, CHURCH, KERR & CO., of New York City, report receipt of cable advice from Noyes Brothers, of Sydney, New South Wales, one of the principal concerns handling American machinery in the antipodes, requisitioning for 30 compound type engines averaging 50 horse-power each. Ten belted generators, aggregating about 800 kilowatts, were ordered at the same time by the firm. These will be manufactured by the Westinghouse Electric & Manufacturing Company. The equipment will be utilized for general power purposes in the British colony.

THE PASSAIC ROLLING MILLS, of Paterson, N. J., which concern is said to have decided on the conversion of its motive power from steam to electric transmission, is at present placing some fair-sized orders rendered necessary by such change. The Harrisburg Foundry & Machine Works have been allotted an order for two 150-hp standard single-valve automatic engines, to be direct connected with two 100-kw generators. These dynamos will be built by the Crocker-Wheeler Company, of Ampere, N. J.

THE PELTON WATERWHEEL COMPANY, New York offices, 143 Liberty Street, has secured a contract calling for 10 miles of riveted steel pipe, which will be utilized by a large tin mining company in the Malay Peninsula. The pipe varies from 8 inches to 24 inches in diameter and will aggregate a weight of 900 tons, approximately. The contract stipulates for completion of shipment within six months.

THE HARRISBURG FOUNDRY & MACHINE WORKS, Harrisburg, Pa., have secured an order, through their New York office, for a 100-hp tandem compound engine, driving a fan load in one of the principal hotel establishments located in Minas, Brazil. The requisite generator—a 60-kw machine—together with several large fans, is being supplied by the General Electric Company.

MESSRS. R. ROGERS ET CIE., of Paris, France, have placed an order with Westinghouse, Church, Kerr & Co., of New York City, for one 80-hp and one 55-hp compound engine, together with a 30-hp simple engine, to be used for electric light purposes in the French capital.

J. J. REIDY, New Haven, Conn., reports that the War Department has just shipped eight cases of his Donnelly improved steel climbers, complete with straps, to the Philippine Islands for use by the Signal Corps there.

THE AKRON ELECTRICAL MANUFACTURING COMPANY, Akron, Ohio, expects to double its capital stock in the near future, owing to its increased business.

THE HAINES & NOYES COMPANY, Chicago, reports a steady growth of business. Among the contracts closed through its private telephone plant department are a complete local and long-distance telephone system for the new Beaumont Hotel at Beaumont, Texas. This includes a 100-drop annunciator switchboard. The drops are of the target type, and the switchboard contains the company's latest clearing-out drop. This board is equipped with two trunk lines to the city exchange. The telephones are the "Style 41," which are very small and compact, and are for local and long-distance use as well as for interior use. The annunciator switchboard and telephone backboards are all in golden oak. Messrs. Miller & Tuggle, of Beaumont, are to install the system. Another large private plant has been installed in the works of the American Car & Foundry Company, Chicago. This company is also equipping the Hahnemann Hospital and the R. A. Waller High School, Chicago, with complete plants. Through the St. Louis Electrical Supply Company and the Lindsey Electrical Supply Company they have recently installed several large plants in St. Louis. They have also closed several contracts for exchanges during the past week; among them may be named Elma, N. Y.

CALCIUM CARBIDE.—For years past the electricians of the world have been experimenting with electric furnaces with a view of making them successfully continuous. If reports are true, it would seem to have fallen to the lot of an American to achieve success where electricians of many countries have failed, even though he did not live to enjoy his success. In April, a patent covering an improvement in electric furnaces was issued to F. J. Patten, the well-known electrical engineer who died in this city last November. The patent which is owned by the Columbian Carbide Company, of New York City, is of the open hearth type, and in the opinion of the electrical experts who have examined it, fully satisfies all the requirements of a strictly continuous furnace. The company owning it is about to build a large plant, where its secret processes in conjunction with furnaces of the above type will be employed in the manufacture of calcium carbide upon a huge scale. We regard this move as a most important one, and with our readers shall watch the result with interest, in view of the fact that the carbide industry of this country has hitherto been in the hands of one company which seems to have had a monopoly of the trade.

KELLOGG TELEPHONE SALES.—The Kellogg Switchboard & Supply Company, of Chicago, is busy over several new contracts for large telephone exchanges. Among the recent orders for small switchboards, varying in size from 50 to 300 lines, are the following: Williamsburg, Pa.; Russell, Iowa; Somerset, Pa.; Chrisman, Ill.; Webster, S. D.; Grandbury, Texas; West Chester, Pa.; Bartelsville, I. T.; Bishop Hill, Ill.; Woonsocket, S. D.; Tama, Iowa; Royersford, Pa.; Columbus Junction, Iowa; Little Rock, Ark.; Marco, Ind.; Shawnee, Ohio; Canadian, Texas; Troy, Ind.; Savannah, Ill.; Chadwick, Ill.; Black River Falls, Wis.; Astoria, Ill.; Concordia, Kans.; Ashland, Ky.; Blue Rapids, Kans.; Greenleaf, Kans.; Huntingburg, Ind.; Virginia, Ill.; Logan, Kans.; Hurley, S. D.; Sparta, Ill.; Miltonville, Kans.; Scandia, Kans.; Streetsville, Ohio; Lexington, Miss.; Story City, Iowa; Versailles, Mo.; Dalton, Ohio; Doylestown, Pa.; West Grove, Pa.; Westphalia, Ind.; Linton, Ind.; Clifton, Kans.; Sanborn, Ind.; Estelline, S. D.; San Francisco, Calif.; Joy, Ill.; Blue Earth, Minn.; Augusta, Ill.; Sullivan, Ind.; Dawson, Minn.; Wellsboro, Pa.

RAILWAY SHOPS.—The Lake Shore & Michigan Southern Railway Company has completed plans for immense repair shops to be located at Collinwood near Cleveland. The locomotive shops and the blacksmith and car machine shop will be of steel construction, and bids for their construction will be asked for within a few days. There are to be three other buildings of large size, including a power house. All machinery will be electrically driven, and the power equipment will consist of boilers of 1800 horse-power, with engines to correspond; one 400-kw direct-current generating set; one 80-kw generating set, one 1300 cubic-foot air compressor. Bids for the three buildings and the power equipment will be called for in the near future. Contracts for four large cranes have been placed with the Philadelphia Engineering Company, Philadelphia, as follows: One 100-ton electric traveling crane, one 30-ton, one 10-ton and one 7½-ton crane. A large amount of machinery will be required, but bids will not be called for for some months.

THE AMERICAN STOKER COMPANY reports receipt of contracts for automatic underfeed stoker equipments for installation in the Monterey and Asclentes (Mexico) plants of the American Smelting & Refining Company. Seven equipments, each having a capacity of 2000 lbs. of coal an hour, will be utilized in the first-named plant, while three machines of similar description have been ordered for Asclentes. The United States Government has also requisitioned for three stokers to be shipped for the new pumping station at Havana. These equipments will have an hourly capacity of 800 lbs. of coal each. The largest domestic order recently obtained was received from the Cincinnati Edison Electric Company, which is to be furnished with no fewer than 26 automatic stokers for installation in its principal power station. These machines are each to have a capacity of 2000 lbs. an hour.

MATERIAL FOR ECUADOR.—Dr. José Maria Borgia, former Consul-General and Acting Minister to the United States from Ecuador, who has been in New York City for some time, has started for home. Before leaving he said: "I have been making arrangements for the shipment of machinery for the better development of our gold fields. In a few months we shall have more than 300 dredges there worked by electricity. Orders have also been placed with the American Bridge Company for more than $2,000,000 worth of bridge material, to be used in the completion of the Guayaquil & Quito Railroad, a very necessary adjunct to the successful working of the mines. We consider our gold fields, when fully operated, will prove the richest in the world."

ORDERS FROM BLOOMINGTON, IND.—The Bloomington Light, Heat & Power Company has placed an order for 5000 lights transformer capacity with the Kuhlman Electric Company, of Elkhart, Ind. It has also let a contract to the Fort Wayne Electric Works for a 100-kw alternator and to the General Electric Company for 100-light capacity on the Hartford arc system. It will put in Chandler & Taylor boilers, Stillwell-Bierce heaters and Gardner pumps. It will use the Cutter mast-arm for street lights, and the Cutter absolute cut out. Mr. A. M. Barron is general superintendent.

THE BROWN HOISTING MACHINE COMPANY, of Cleveland, Ohio, has practically completed plans for the erection of a new plant to take the place of the one destroyed by fire some months ago. The main plant will cover almost an entire square 500 by 312 ft. There will be seven buildings, each of which will be covered by a crane. All the machinery will be electrically driven. There will be an independent power house equipped with three units of 250-kw capacity each. Contracts have not yet been placed.

TEXAS TROLLEYS.—E. P. Roberts & Co., of Cleveland, Ohio, engineers for the Northern Texas Traction Company, have closed contracts for the equipment of the power house at Dallas. It will consist of two 600-kw alternating-current generators, two 300-kw rotary transformers, two 400-kw rotary transformers, all of Westinghouse make, and two 900-hp Cooper Corliss cross compound engines.

ELECTRICAL MACHINERY IN MEXICO.—Mr. Charles E. Sharp, of St. Louis, representing an electrical supply house of that city, has been making his semi-annual business tour of Mexico. He reports that the demand for electrical machinery in that country is constantly increasing. He says that his company will establish a supply house at some large distributing center in Mexico in the near future.

POWER COMPANY.—The Connecticut Senate has passed a bill giving permission to the Consolidated Lake Superior Power Company to engage in operating railroads, steamers, express business, furnishing water and electric light, etc. The company has a capital stock of $20,000,000, and Mr. Lynde Harrison, of New Haven, is president.

GREAT DEMAND FOR RAILS.—A representative of the Cambria Iron & Steel Works is quoted as saying that the great activity in the construction of electric lines has swamped rail mills with business. The Cambria Company is refusing orders for rails for earlier than October delivery, and other rail mills are reported to be in even worse condition.

THE AMERICAN BRIDGE COMPANY has been awarded a contract for the erection of the buildings for the plant of the Youngstown Engineering Company at Youngstown. The latter company will engage in the manufacture of electric cranes and heavy castings.

TROLLEYS IN ILLINOIS.—The Aurora, Elgin & Chicago Electric Railway Company has placed contracts for four 2200-hp Cooper Corliss engines, 8000-hp Edgemore boilers and General Electric Company generators.

A 12-POINT AUTOMATIC TELEPHONE SYSTEM for use in Colombia, South America, has been purchased by the United Fruit Company from the Clark Automatic Telephone Switchboard Company, Providence, R. I.

THE EXETER MACHINE WORKS, Pittston, Pa., are at present installing their gravity system of coal conveying, etc., at the Twenty-ninth Street station of the New York Gas, Electric Light, Heat & Power Company, New York City.

BALL ENGINE CONTRACT.—The Mount Washington Electric Light & Power Company, Mount Washington, Md., is installing a 350-hp tandem compound direct-connected engine, purchased from the Ball Engine Company, Erie, Pa.

THE IBERIA ELECTRIC SUPPLY COMPANY has been formed at New Iberia, La., and will do a construction and supply business. Mr. A. G. Nauch, president, writes us that the company will be glad to receive catalogues, price lists, etc.

Special Correspondence.

ENGLISH NOTES.

London Office, ELECTRICAL WORLD AND ENGINEER, April 20, 1901.

THE SOUTH WALES ELECTRICAL POWER DISTRIBUTION COMPANY, which succeeded in getting its bill through Parliament last year under certain restrictions, is taking steps to exercise the powers it possesses. Negotiations are proceeding for the land required for stations at Pontypool, Pontypridd, and Neath, and from these centres it intends to supply electricity for lighting or motive power to local authorities at a cheap rate. Matters have now so far advanced that offices have been taken opposite the Park Hotel, Cardiff, and practical operations will soon be commenced.

THE ELECTRIC TRAMWAY EQUIPMENT COMPANY, of Birmingham, recently got an order from the Southport corporation for overhead line material to be delivered, one-half in two months and one-half in four months, imposing a penalty for late delivery of £1 a day for the first half and 10s. per day for the second half. The corporation, however, very justly offered a like premium as an inducement for early delivery, and it is interesting to note that the company referred to, having secured the contract, delivered the first half in one week and the second half in two weeks and so earned for itself a very satisfactory premium, in addition to the price which it had already received. This goes to show that English manufacturers can rise to the occasion when there is a necessity for it and speaks volumes for the management of this energetic young company in the manufacture of insulating material for overhead line purposes.

BRUSH ELECTRICAL ENGINEERING COMPANY.—At the twelfth annual general meeting of the Brush Electrical Engineering Company, Limited, Mr. J. B. Braithwaite, Jr., M. I. E. E., chairman of the company, said that the large extension to its factory upon which work has been carried on for the past year is now completed. The new car shops are completed and fully equipped for work. The company is now in a position to turn out electrical cars of British manufacture throughout. That is to say, that the Brush Company manufactures at its own works, not only the car bodies, but the motors, controllers, the frames and the trucks themselves, the last item being an entirely new departure for the company. The most important event which the chairman referred to was the working agreement which had been entered into between the Brush Company and the British Electric Traction Company. That agreement has only been in force for a short time, but had, the chairman believed, already brought them important orders for engines, electric generators, and electric tramway rolling stock, etc.

ELECTROLYSIS AT SHEFFIELD.—The Sheffield corporation met with very determined opposition recently when its bill for electric tramway extensions came before the House of Lords committee, and the bill has only been allowed to proceed with the following clause inserted, and which was requested by the Sheffield United Gas Company: "Provided that, notwithstanding anything contained in the said acts or this act, if it be proved that any injury, or damage to any mains, pipes, or apparatus of the Sheffield United Gaslight Company shall have resulted from fusion or electroyltic action caused by any currents generated or used for the purpose of electric traction or any of the tramways for the time being belonging to the corporation, nothing in the said acts or this act shall relieve the corporation from any liability to make compensation for such injury or damage which would have existed but for the passing of the said act and this act." Mr. A. L. Fell, the corporation electrical engineer, protested that every precaution had been taken, and that there was no danger of electrolytic action, while both Mr. H. F. Parshall and Mr. Robert Hammond confirmed Mr. Fell's opinion, and stated that the present Board of Trade rules were ample to insure safety. Professors J. Perry and W. E. Ayrton, however, maintained that great danger of electrolytic action did exist, and the committee finally decided as stated above.

THE LONDON UNDERGROUND.—There is a growing impression in London that Mr. Charles T. Yerkes has really secured the control of the Metropolitan District Underground Railway. A large amount of stock in this railway has recently been bought up, and it is now only a question of time when a satisfactory announcement is made as to what will ultimately be done with this underground system. The old Metropolitan and District Railways in London form a very valuable property, and the mere fact that they are not deep down in the ground, like the "tube" service, appeals to a large class of people. Were the Underground Railway converted to a system of electric traction and run on slightly different principles there is no doubt but what a much larger business could be done and that a dividend could be paid on the stock. It does not seem to the casual observer that the full service is got out of the tunnels penetrating London, and by thoroughly renovating the line, introducing newer and more modern styles of rolling stock, giving a quicker acceleration, and therefore a more frequent car service, the old London Underground would undoubtedly prove a much more formidable rival to the new tube method than is at present the case. In the meantime it is interesting to note that the District Company has announced a wholesale reduction in fares, the granting of third class season tickets and a number of other accommodations forced by competition.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—A telephone line extension is projected from Gold Hill, Oregon, to Crescent City.

SAN FRANCISCO, CALIF.—The Oakland, Calif., city council has directed the auditor and treasurer to collect at once an annual ground rental of $2.50 for each telephone and telegraph pole in that city. The companies owning such poles have heretofore failed to comply with the ordinance passed in 1894 imposing the tax.

CITY OF MEXICO, MEX.—The long distance telephone movement is having a rapid growth in Mexico. Among the lines recently constructed and now in successful operation is that connecting Jalapa with Janacapa, Astapa, Cacaos and Puebla Nuevo, and which will soon be extended from the latter place to San Juan Bautista, the capital of the State of Campeche. A telephone line has also recently been completed connecting Comalcalco with Teculutilla and Aldama.

MINNEAPOLIS, MINN.—The Twin City Telephone Company, which lately bought up the St. Paul and Minneapolis exchanges of the Mississippi Valley Telephone Company, is about to expend over $500,000 on improvements on its telephone system in Minneapolis alone. The improvements will consist of the erection of a main exchange building, the entire cost of which will be about $100,000; the erection of a sub or branch exchange, to cost nearly $30,000, and the erection of an east side exchange, which will involve an expenditure of nearly $100,000.

HENDERSON, N. C.—The stockholders of the Henderson Telephone Company have authorized an increase in their capital stock to $100,000, in order to meet the demands of increasing business.

CHARLOTTE, N. C.—The Charlotte, N. C., Telephone Company, the old "Queen City Company," recently purchased by the Curtis Syndicate, of New York, has been chartered with $30,000 capital. J. B. Curtis, of New York; J. I. Taylor and A. A. Miller, of Charlotte, are the corporators.

CADIZ, OHIO.—The Cadiz Home Telephone Company will commence operations in the near future with 125 subscribers.

WINDHAM, OHIO.—The Ravenna Home Telephone Company is trying to secure a franchise here. The Bell Company is building a line from this place to Garrettsville.

WAUSEON, OHIO.—The Northwestern Ohio Telephone Company is preparing to install sub-exchanges at Tedrow and Pettisville. The National Automatic system will be tried as an experiment.

FINDLAY, OHIO.—The Findlay Home Telephone Company is rushing work on its exchange, and it is expected that it will be connected up shortly after May 1, as originally planned. Business will open with about 750 subscribers. Rates are $18 per year for residences, $24 for offices, $30 for business houses and $18 for farmer's lines and village connection.

COLLINWOOD, OHIO.—The Collinwood Home Telephone Company held its annual meeting recently, when the company was reported to be in excellent financial condition. There are 320 telephones in operation with 22 on a waiting list. A 2½ per cent. dividend was declared and arrangements made for new equipment. The officers were re-elected as follows: J. M. Hart, president; W. G. Griswold, secretary-treasurer; directors, E. L. Barber, W. F. Parsons, Dr. J. S. Wood, S. O. Davis, J. M. Hart and W. G. Griswold.

CLEVELAND, OHIO.—Mrs. M. A. Brett, who assisted her husband in the management of the old independent exchange at Detroit, and who since the death of Mr. Brett some time ago has been promoting independent exchanges in Texas, was in this city recently interesting local capitalists in the organization of a company to build an exchange at El Paso, Texas. Mrs. Brett has secured the franchise and has contracts from about 75 per cent. of the telephone users in that city. Her Cleveland mission was successful and the exchange will be built at once.

PITTSBURG, PA.—The Bell Telephone Company, of Greenville, Pa., has raised the rates 33 per cent. for the district embracing Greenville, Sharon, Sharpsville, Mercer and Grove City. This has caused the subscribers to get up an indignation meeting, and a committee has been appointed to confer with the independent telephone company to ascertain whether it means to maintain the present rate. So far they have not been able to get any satisfactory reply, and it is rumored that both companies are about to consolidate.

RICHMOND, VA.—It is said that the question of a consolidation of the various telephone companies at or in the vicinity of Newport News, Va., especially the long-distance lines to Richmond, seems to be approaching a crisis. The officials have nothing to say, but the statement is made that it is not to be doubted that the two companies have come to the conclusion that there is little possibility of both lines being able to live, while a combination would render the stock a paying investment.

KENOSHA, WIS.—The city is trying to force the Wisconsin Telephone Company to put all its wires underground, in the business district of the city.

ELECTRIC LIGHT AND POWER.

ARKADELPHIA, ARK.—J. W. Urlson, of Arkadelphia, has bought the plant of the old water and light company for $12,000. Five dynamos will be installed at once and for a light and water service will be resumed at an early date.

WILMINGTON, DEL.—A charter was issued at Dover to the General Engineering Company of Brooklyn, which is to construct, maintain, and operate gas and electric works; capital, $250,000.

SAN FRANCISCO, CALIF.—The Truckee River General Electric Company is reconstructing the lines of the local electric lighting system, recently purchased by that company.

SAN FRANCISCO, CALIF.—The Hale & Norcross tunnel on the Comstock Lode, Virginia City, Nev., has been connected with Truckee River General Electric Company's lines. Electric power will be supplied to drive ventilating fans and to light the tunnel.

SAN FRANCISCO, CALIF.—It is reported that the Woodland Consolidated Electric Light, Gas & Power Company, of Woodland, Calif., has sold all of its holdings and business to the Woodland Gas & Electric Company. The last-named company will distribute the current furnished by the Bay Counties Power Company's electric transmission lines.

SAN FRANCISCO, CALIF.—The Ventura Water, Light & Power Company was recently incorporated, with Los Angeles, Calif., as the principal place of business. Directors: J. H. Adams, T. W. Phillips, T. W. Brotherton, J. M. Gardner, F. E. Trask, Los Angeles; W. R. Staats, J. S. Torrence, Pasadena. Capital stock, $500,000; all subscribed.

SAN FRANCISCO, CALIF.—The Black Diamond coal mine, in the State of Washington, is being improved by the installation of electric hoists and an electric motor haulage system. A new 8-foot ventilating fan is now in operation. Electric haulage has also been introduced at the Roslyn coal mines, operated by the Northern Pacific Railroad Company in Western Washington.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company has commenced supplying current for commercial purposes to the various sub-stations along the lines of the Standard Electric Company, including the Oakland and San Jose stations. The main generating station, on the Yuba River, is 140 miles from the end of the lines and the current will be transmitted at 40,000 volts. On account of the delay in completing the Standard Company's system, the Yuba supply will be depended upon for six or eight months. The Bay Counties Power Company will soon have its own commercial circuits in operation to Vallejo, Oakland and elsewhere, and the line voltage will be increased to 50 and then to 60 kilovolts as load increases.

BRAZIL, IND.—The city is taking steps to put in and operate an electric light plant. A company of Indianapolis men offer to establish the plant, to be paid for in installments.

RICHMOND, IND.—The Richmond City Council has decided to locate the power-house of the municipal electric light plant on ground owned by the city in the river bottoms instead of in the city parks.

CARTHAGE, IND.—The city council has granted a franchise for an electric light plant and contracted for lighting for ten years, at the expiration of which the city shall have privilege to buy it at a fairly appraised value.

RICHMOND, IND.—In the suit brought by local taxpayers to prevent the construction of a municipal electric light plant and enjoin its location in the city park, Judge Fox ruled in favor of the city. This is thought to be the last move of the opposition, and the plant will now be speedily constructed at a cost of $144,000.

INDIANAPOLIS, IND.—The city engineer is preparing specifications for a new public electric lighting contract, and the Board of Public Works will receive bids and let the contract within the next sixty days. The fact that the present contract with the Indianapolis Light & Power Company does not expire for two years arouses some curiosity, but the board says it is for the purpose of giving the successful bidder sufficient time to put in a plant. The Home Heating & Lighting Company, now constructing a plant, will be a bidder.

NEW ALBANY, IND.—A joint meeting of the committees from the commercial clubs of this city and Louisville was held recently, and steps were taken toward utilizing the immense water power of the Falls of the Ohio at this point. The plan is to dig a canal on the Indiana side of the river from a point at the head of the falls above Jeffersonville to a point just below this city, where it will empty below the falls. This power will be utilized to generate electricity for the three cities, the street railway companies and the surrounding country.

CITY OF MEXICO, MEX.—The contract which the city council of the town of Culiacan, the capital of the State of Sinaloa, Mexico, made with a firm for the electric lighting of that place, has been rescinded owing to the failure of the contractors to fulfil the stipulated conditions.

CITY OF MEXICO, MEX.—The large electric generating plant operated by water power owned by Sebastian Robert & Company, of the City of Mexico, is now furnishing lights for the suburban towns of Tlalpam, San Angel, Coyoacan and Mixcoac. The plant is located at Tizapan.

CITY OF MEXICO, MEX.—Good progress is being made in the construction of a large electrical plant on the top of a mountain near Oblate, in the State of Jalisco, Mexico, by an American syndicate. The plant will supply power to factories and other industrial concerns located in towns of that section. At Las Juntas power from this plant to the amount of 18,000-hp has already been contracted for.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company has nearly completed moving its sub-station into new quarters on Fifth Street. The storage battery plant remains to be moved, and will be enlarged when re-installed in the new building. The work was begun at 12 o'clock on a Saturday night and on the following Monday one-half the equipment, consisting of 1500-hp of transformers, rotaries, switchboards, etc., was moved, underground cable connections made, and again put into service. The other half of the equipment was moved on the following Sunday.

ST. LOUIS, MO.—The Collins Electric Company has been incorporated, with a capital stock of $100,000, all paid, by William F. Kemper, Ulysses L. Collins, F. William Gunnamann and Wm. S. Cowan.

ST. LOUIS, MO.—The National Electric, Gas, Water & Power Company, through its president, Geo. A. Gable, has filed an application with the County Court asking for a franchise to lay pipes and conduits on various streets in St. Louis County. As a compensation it offers the county 1 per cent. of its earnings for the first four years, 2 per cent. for the next three years and 3 per cent. for the other forty-three years of the franchise.

CHARLOTTE, N. C.—The street and finance committees of Charlotte have decided to pass an ordinance on May 6 granting a franchise to F. Van Deventer and others, provided a $10,000 indemnity bond shall be given, to develop power at Mott's Falls, thirty miles from Charlotte. The contemplated work will cost about $800,000.

EGG HARBOR CITY, N. J.—The power house of the Egg Harbor City Electric Light plant was totally destroyed by fire on April 19. The loss is about $10,000.

ALBANY, N. Y.—The Hudson River Electric Company has been incorporated, with a capital of $1,000,000. The company is organized to construct dams across the Hudson River in Saratoga, Warren and Washington counties and elsewhere, and on other streams; and to furnish light, heat and power to cities, towns and villages in Saratoga, Washington, Fulton, Montgomery, Rensselaer, Albany, Schenectady, Essex, Clinton, Franklin and other counties. The directors are C. H. Peddrick, Jr., and J. M. Warren, of Spier Falls, Saratoga county, and Henry W. Williams, Robert DeLong and F. R. Baker, of Glens Falls.

CONNEAUT, OHIO.—The municipal lighting plant here has been overhauled and new equipment installed.

NILES, OHIO.—The citizens of this place have voted against the issuance of bonds to purchase the Niles Electric Company's plant, which is running in opposition to the municipal lighting plant.

HAMILTON, OHIO.—The municipal lighting plant is greatly overloaded, and as there are no funds to provide for additional equipment, the director of public works has been authorized to rent or lease an extra generator.

MARION, OHIO.—The Marion Electric Light & Power Company has contracted for equipment to double its present capacity. A new 200-hp generator will be installed about June 1, and other equipment soon after.

CRESTLINE, OHIO.—The Crestline Electric Light Company's plant was sold at sheriff's sale in Bucyrus recently. It was bought in by the First National Bank, Crestline, and John A. Roebling's Sons Company, of Trenton, N. J. The price paid was $16,667. The plant will continue in operation.

COLUMBUS, OHIO.—Engineer Ellicott, who was retained by the council lighting committee, to prepare estimates on the cost of a plant to furnish lights for the entire city, has submitted a detailed report giving approximate figures for the cost of the equipment, the total amount being $100,275, exclusive of considerable available equipment in the present plant. Among the items are the following: Two 800-hp cross compound engines, $16,000; two 500-hp water tube boilers, $8,400; three 160-light arc generators, $9,000; 600 all-night service arc lamps, $7,200; poles, wire, brackets, etc., $30,000; building and stack, $18,000. Mr. Ellicott calculates that lights could be furnished from such a plant for $45 per year, and that in three years the saving over present prices would pay for the plant. In view of these figures the board of public works has decided to reject the bids for lighting submitted a short time ago by several companies, the lowest figures being $78 per year for all-night service on a ten-year contract for not less than 850 lamps. It is reported that a new company will be organized, in case the bids are rejected, which will agree to furnish all the lamps necessary at $70 per year, giving bond to the city of $100,000 for the faithful performance of the contract. In addition it will agree to purchase the present municipal plant at figures fixed by appraisers.

YORK, PA.—The Susquehanna Electric Power Company has been organized with the following directors: John K. Cowen, Alexander Brown, John Henry Miller, George K. McGaw and J. B. Ramsey. The capital is $12,000,000. The power house will be one of the largest in the world and will be located at Peach Bottom, York County. The United Railways of Baltimore have contracted for 20,000-house power, with the privilege of increasing to 40,000 horse power.

SEATTLE, WASH.—An ordinance has been introduced in the city council requiring all wires in paved streets to be placed underground. Also, all wires are to be placed in underground conduits in streets hereafter paved.

MILWAUKEE, WIS.—The Fred Miller Brewing Company will install an electric power plant, consisting of a 75-kw direct current direct-connected unit, switchboard and 10 to 15 motors.

MILWAUKEE, WIS.—The Consolidated Current Company has contracted for an electric lighting and power plant at its works. There will be a 25-kw generator, switchboard, three motors and electric light. Julius Andrae & Sons Company, of this city, have the contract.

MILWAUKEE, WIS.—Kroeger Bros. will install a complete electric power and lighting plant in their new department store. The plant will consist of one 75-kw, and one 35-kw, direct-connected units, switchboard, two electric elevators, electric ventilator and arc and incandescent lights. Iron conduit will be installed.

THE ELECTRIC RAILWAY.

SPRINGFIELD, ILL.—The Secretary of State has licensed the Freeport Electric Railway Company, with a capital stock of $50,000. The principal office is at Rockford, Ill. The incorporators and first board of directors are: Thomas M. Ellis, John H. Catlin, George A. Wilson, Thomas E. Reber and Frank L. Puffer, all of Rockford, Ill.

BALTIMORE, MD.—A forty-year franchise has been granted to C. E. Fink and Dr. F. T. Shaw at Westminster allowing the use of the streets for an electric railway system.

BALTIMORE, MD.—The incorporators of the Washington & Annapolis Electric Railway Company are trying to interest Philadelphia capitalists and the Johnson Street Railway syndicate in a plan to construct a trolley line from Philadelphia to Baltimore. The scheme contemplates a continuous trolley system from New York to Washington by way of Philadelphia, Wilmington, Del., and Baltimore.

EAST ORANGE, N. J.—Essex County capitalists, among them Francis M. Eppley, are trying to secure rights of way for a new trolley line between Bloomfield and Irvington.

JERSEY CITY, N. J.—President David Young, of the North Hudson County Railway Company, Hoboken, states that his company has consolidated with the Jersey City, Hoboken and Paterson Street Railway Company.

NEWARK, N. J.—The Bergen Turnpike Company has borrowed $1,000,000 and will build a trolley from Hoboken to Hackensack.

ALBANY, N. Y.—The New York & Port Chester Railroad Company has been incorporated to operate an electric street surface road twenty-five miles long, from the Harlem River at Port Morris through the Borough of the Bronx to Mount Vernon, Pelham Manor, New Rochelle, Larchmont, Orienta, Mamaroneck, Milton, Rye, and Port Chester, to the Connecticut line, with a branch to Classon's Point, on the East River. The company has a capital of $250,000, and the directors are Charles Heinecke, of Whitestone; M. F. Germond, of Dumont N. J.; W. H. Heath, of Brooklyn; M. W. Baldwin, E. D. Mailloux, Mesmore Kendall, Christopher Kaiser, C. O. Mailloux, of New York City, and Ernest Muller, of Westfield, N. J.

ALBANY, N. Y.—It is rumored that the Albany & Hudson Electric Railroad Company is contemplating a branch of its road from Brookview to Castleton.

RAVENNA, OHIO.—The city council has granted a franchise to the Northern Ohio Traction Company.

MARTIN'S FERRY, OHIO.—The Steubenville & Monroe Traction Company has asked for a franchise in this place.

SPRINGFIELD, OHIO.—The Columbus, London & Springfield Railway Company has secured its franchise in this county.

DAYTON, OHIO.—The Dayton & Troy Electric Railway Company has increased its capital stock from $30,000 to $1,000,000.

CLEVELAND, O.—The Everett syndicate, of Cleveland, which recently acquired the Detroit Street Railway system, has purchased the Detroit & Toledo Shore Line.

MT. GILEAD, OHIO.—The Commissioners of Morrow county have granted a franchise through the county to the Mansfield, Mt. Gilead, Cardington & Delaware Railway Company.

COLUMBUS, OHIO.—The Columbus, Delaware & Northern Railway Company has secured a 90-day option on the properties of the Delaware Electric Street Railway Company.

ZANESVILLE, OHIO.—The Newark, Zanesville & Coshocton Railroad Company has been incorporated by J. M. Ickes, Charles H. Hunt, J. K. Hamill, C. H. Geidel and W. O. Littick.

AKRON, OHIO.—The Akron South Side Belt Line Railway Company, capital $10,000, and the Akron & Barberton Belt Line Railway Company, capital $15,000, have been incorporated.

SEBRING, OHIO.—Several prominent local people have secured an option on the franchise of the Alliance, Sebring & Salem Railway Company, and are endeavoring to raise funds to build the road.

DAYTON, OHIO.—The Dayton & Xenia Traction Company has been incorporated by C. J. Ferneding, H. L. Ferneding, O. O. Ozias, J. E. Carson and Edward Canby. Capital stock, $800,000.

BUCYRUS, OHIO.—The Central Ohio Traction Company has been granted a franchise to build a road from Galion to Crestline. Another company holds a similar franchise and has commenced construction work.

CLEVELAND, OHIO.—A syndicate of Eastern capitalists, headed by A. L. Johnson and Martin Mullen, are seeking to establish a rival street car system in this city. Their purpose is to parallel the present routes and bid for patronage with a 3-cent fare as inducement.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Electric Railroad Company has been incorporated by S. T. Everett, J. W. Holcomb, J. E. Latimer, T. A. Simons, of Cleveland and Lyman Gardner, Richard E. Jones, D. C. Beggs, H. C. Park and F. D. Simons, of Columbus. The company was incorporated for $1,000, but this was increased a day later to $1,000,000.

TOLEDO, OHIO.—A deal is said to have been practically closed whereby the Toledo, Bowling Green & Fremont Railway passes into the hands of George B. Kerper and John Kilgour, Cincinnati capitalists, who own the Findlay Street Railway Company of Findlay, and an extension now being built to North Baltimore. The two lines will be joined at Trombley, the present terminus of the Toledo line, and the extension from Bowling Green to Fostoria will be built.

BAVARIA, OHIO.—The county commissioners have granted franchises to the Cincinnati & Eastern Railway Company, which proposes to build a line from Cincinnati to New Richmond; to the Cincinnati & Hillsboro Electric Railway for a line from Cincinnati to Hillsboro, and to the Cincinnati & Columbus Railway Company, which is promoting a direct line from Cincinnati to Columbus.

FINDLAY, OHIO.—The Toledo & Findlay Traction Company was incorporated a few days ago by George B. Kerper, Henry Bushold, G. B. Kerper, Jr., E. V. Bope and Charles F. Smith. Later the name was changed to the Toledo, Bowling Green & Findlay Traction Company. The capital stock of the company is $1,500,000. It is stated that a large power house will be erected at Findlay.

PHILADELPHIA, PA.—It is reported that Philadelphia and New York capitalists have secured wharf rights in Philadelphia for $450,000 and are to use it as the terminus of an electric railway.

HARRISBURG, PA.—The State Department has issued charters to the West Chester & Wilmington, Chester, Wayne & Norristown, Philadelphia, Wayne & West Chester, Parkersburg & Coatesville, Coatesville, Downington & West Chester, Philadelphia, Norristown & Phœnixville, and Philadelphia, Media & Wilmington street railroads. The total capitalization of the companies is $199,500. Albert B. Kelly, of Philadelphia, is president of the companies. They will build suburban lines in Chester, Delaware and Montgomery counties. Charters were also issued to the Jersey Shore Street Railway Company, Jersey Shore, capital $25,000, and the Reading, Birdsboro & Pottstown Railroad Company, Reading; capital, $10,000.

CHATTANOOGA, TENN.—Clarence P. King and J. H. Jefferis, representing Philadelphia and New York capitalists recently arranged a deal to buy the different Lookout Mountain railways. The purchase price was $92,500. The deal embraces both inclines up the mountain, and the broad gauge railroad. As the result, the northern capitalists now control every means of reaching the mountain. The inclines will have a new equipment and the old broad gauge railroad will be made into an electric railway. The deal also embraces the electric railways on top of the mountain.

FORT WORTH, TEX.—The Northern Texas Traction Company has been incorporated with a capital stock of $1,500,000. The company recently acquired the street railway system in this city and proposes to build an extension to Dallas. The road will be operated on the high tension system, and contracts have been placed with the Cleveland office of the Westinghouse Electric & Manufacturing Company for the power-house equipment and sub-station equipment, consisting of two 600-kw, 100 r. p. m., 400-volt, three-phase alternating current generators; two 250-kw rotary transformers, two 300-kw rotary transformers; two 400-kw rotary transformers; a 14-panel station switchboard and two two-panel sub-station switchboards. A contract has also been closed for two 900-hp Cooper-Corliss engines. E. P. Roberts & Co., of Cleveland, are engineers for the road.

NORFOLK, VA.—A deal by which Baltimore capitalists acquire control of the Berkley Street Railway has been consummated. The road will be operated hereafter in harmony with the Williams syndicate, of Richmond, which controls the Norfolk street railway system, and it is stated the two roads will be connected physically by a line across the Elizabeth River over Camposter bridge.

TACOMA, WASH.—It is believed here that the construction of the new Seattle-Tacoma electric line is a southward movement of James J. Hill, having for its object the ultimate construction of the Great Northern line to Portland, obviating the slow-going run by ocean steamer between the Sound and San Francisco.

SHEBOYGAN, WIS.—The common council has granted to John M. Saemans and P. Brueckhauer the right to construct tracks for the use of the Sheboygan, Plymouth & Elkhart Lake interurban line.

NEW INDUSTRIAL COMPANIES.

THE AMERICAN AUTOMATIC FIRE ALARM COMPANY has been organized at Cleveland, O., with a capital stock of $1,000,000.

THE PORTER BATTERY COMPANY, of Waukegan, Ill., has been incorporated. Capital, $300,000. Incorporators: Blewett Lee, Max J. Spiegel and Samuel Adams.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY has been incorporated at Chicago. Capital, $2,400. Incorporators: W. Clyde Jones, Keene H. Addington, Curtis B. Camp.

PIXLEY ELECTRICAL COMPANY.—Milton A. Pixley, Chas. F. Prior, of Cincinnati; Holstein W. Webb, John F. Pixley and R. Fullerton have incorporated the Pixley Electrical Company at Columbus, Ohio.

THE KINGSTON AUTO-ELECTRIC FIRE ALARM COMPANY, of Kingston, N. Y., has been incorporated. Capital, $30,000. Directors: I. M. Block, J. W. Brewster, of Kingston, and William F. Rafferty, of Rondout.

THE EDISON MANUFACTURING & CHEMICAL COMPANY, of New York, has been incorporated with a capital stock of $400,000. [Note.—We are informed that nothing is known of this company by Mr. T. A. Edison.]

THE LEOKOS COMPANY has been incorporated in New Jersey to carry on the business of supplies of light, heat, and power, with gas and electricity, and to act as carriers of passengers and goods by land and water. Capital, $200,000. Incorporators: Alfred George Brown, Edward B. Hawkins, and Edward T. Magoffin.

THE ESSEX ELECTRIC COMPANY has been incorporated in New Jersey. Capital, $700,000. Incorporators: W. Campbell Clark, Franklin Conklin, Henry Dickson, Bernard Strauss, Jacob Haussling, Richard C. Jenkinson, Julius H. Lebkeucher, Simon Scheuer, Robert H. McCarter, Moses Straus and J. Broadhead Woolsey.

PERSONAL.

MR. STEPHEN L. COLES, who recently resigned as managing editor of the *Electrical Review*, of New York City, after twelve years' service with that journal, announces that he has associated himself with Mr. M. J. Shaughnessy, of New York City, in the business of preparing and publishing technical and trade literature and advertising for manufacturers and others who wish really helpful assistance in such matters. The relation between these gentlemen and their clients is very similar to that between lawyer and client. Mr. Shaugnessy is well known among general advertisers. He organized the advertising department for John Wanamaker when the latter began business in New York City. He also prepared and placed advertising for the first Electrical Show at the Grand Central Palace, New York, in 1896, which will be recalled as a great success. Mr. Coles has many warm friends and acquaintances in the electrical and allied industries. Through his long experience in technical journalism and other newspaper work he is thoroughly posted as to the needs of manufacturers and others seeking the widest and best publicity for their product. Messrs. Shaughnessy and Coles are established in Temple Court, 5 Beekman Street, New York City, where the friends of both will be welcome.

STEPHEN L. COLES.

M. J. SHAUGHNESSY.

MR. E. D. ADAMS, the banker, of Niagara power fame, has gone abroad for a recreation trip of some weeks' duration.

MR. PHILIP H. TROUT, the city electrician of Lynchburg, Va., has been a visitor in New York City during the past week.

MR. H. F. TATE has opened an office at 416 Rookery, Chicago, as Western representative of the National Conduit & Cable Company.

MR. C. C. CUTTRISS, electrician of the Commercial Cable Company, has just returned to New York, after a trip across the water to the Old Country.

MR. ROBERT S. TODD, general manager of the Cincinnati Traction Company, was recently married in New York City to Miss Charlotte Louise Vinal.

MR. CLARENCE H. MACKAY was injured at polo last week while playing at Lakewood, N. J., his collarbone being fractured. He was able to leave for his country home at Roslyn, L. I.

MR. HINSDILL PARSONS, whom Mr. Coffin speaks of as the "able head of the law department at Schenectady," has recently been elected fourth vice-president of the General Electric Company.

MR. CESARE PIO, an Italian electrical engineer who is known in this country through his contributions to the technical press here, is now visiting New York, Niagara and other points of electrical interest.

MR. RAY D. LILLIBRIDGE, who is making a distinct success as an editor of advertising matter of all kinds, has just issued from his office at 20 Broad Street a very neat little pamphlet on his work as a "systematist" in this field of work.

MR. G. WESTINGHOUSE has sailed for Europe, with Mr. H. S. Loud, managing director of the British Westinghouse Electric Company, who has been buying machine tools here for the new shops in England. Mr. Loud will return shortly.

MR. EARL BULL delivered an amusing address recently before the advanced and elementary classes of the Dayton, O., Y. M. C. A., on the subject of the future of electricity. He sees several new branches of electricity in full operation by 1950.

MR. MAURICE HOOPES, formerly of the General Electric Company, who had charge of the work in building and starting the third rail road between Albany and Hudson, in New York State, has now joined the staff of J. G. White Company.

PROF. DR. AUG. RAPS, of the Berlin works of the Siemens & Halske Company, of Germany, is now visiting this country and looking up telephonic development here, that being the branch of electricity to which he is devoting special attention.

MR. J. E. WIDENER, son of Mr. P. A. B. Widener, was seriously hurt in Philadelphia last week by the overturning of a four-in-hand, whose wheels caught in some car tracks. He is the second son of the street railway magnate and is 29 years old.

MR. W. J. HAMMER lectured before the electrical section of the Franklin Institute, Philadelphia, on April 18, on the electrical features of the Paris Exposition of 1900. It was well illustrated and, as might have been expected, a valuable review of the subject.

MR. T. G. GRIER, Western manager for the American Circular Loom Company, has moved his offices to the Electrical Building, 128 West Jackson Boulevard, Chicago. The old quarters at 141 South Clinton Street, have been taken by the Aaron Electric Company.

MR. EDWIN HOLMES, late president of the Holmes Protective Company, who died last January, is being remembered by his associates in various ways. The resolutions of the company, beautifully engrossed for the family, are on view at Gorham's downtown establishment.

ECKERT—MATHEWS.—The marriage is announced of Miss Helene Jane, daughter of Mr. W. H. Eckert, president of the Knickerbocker Telephone Company, to Mr. A. E. Mathews. The ceremony was performed at the residence of the bride's father by the Rev. N. P. Carey.

MR. R. E. JENNINGS has recently accepted the presidency of the Menominee Electric Manufacturing Company, Menominee, Mich. Mr. Jennings is one of the leading business men of the city, and consequently the future of this company is assured. Affairs will be pushed with energy and persistence.

MR. R. B. HAMILTON has succeeded Mr. E. E. Carey as manager of the Packard Electric Company, Limited, the latter resigning from ill-health. Mr. Hamilton has been acting manager for some little time past, and his technical and business qualifications ensure a satisfactory administration of affairs. Mr. G. A. Powell will take the management of the Packard sales department.

MR. H. WRAY WELLER, formerly of the Sprague and General Electric engineering staffs, and for some time past representing the interests of the Babcock & Wilcox boiler for Canada, was a welcome visitor in New York last week. Mr. Weller, who is an English civil engineer, finds himself very much at home in Canada and has succeeded remarkably well in his present work.

MR. GUGLIELMO MARCONI is engaged to be married to an American girl. His fiancée is Miss Josephine B. Holman, a cousin of the late Congressman W. G. Holman, of Indiana, known as "The Watchdog of the Treasury." Her father was the late Justice J. A. Holman, of the Supreme Court of Indiana. Mr. Marconi met his intended wife on board ship in his recent trip to this country. He sailed for Europe last week, but it is said that the ceremony will be performed in this city in the Fall.

MR. GEORGE W. FOWLER, of the engineering department of the C & C Electric Company, left last week for the Pacific Coast, where he will supervise the installation of several C & C series-parallel equipments for operating newspaper presses. His company will be glad to hear from any parties on the Coast who are contemplating the installation of any direct current electrical machinery, especially electric power transmission plants, and Mr. Fowler will call on those interested, while out on the Coast.

MR. ALFRED HAY, who has lately received the D. Sc. degree in "Engineering Science" from the Edinburgh University, and who was lecturer on electrotechnology at Liverpool University College, has just been appointed professor of the same subject at the Royal Indian Engineering College, Cooper's Hill. Dr. Hay was one of Professor Andrew Jamieson's old students and assistants at the College of Science and Arts, Glasgow, as well as an apprentice with Mr. McWhirter, at the Faraday Works, Govan.

MR. R. W. RYAN, for many years past the official stenographer of the American Institute of Electrical Engineers and of other technical bodies, has just secured one of the prizes of his profession in the appointment as official stenographer in the New York Supreme Court. Mr. Ryan was No. 1 on the Civil Service eligible list, which will not surprise any one who knows him. He is not only an accomplished stenographer, but a member of the New York bar, and remarkably well informed on all technical subjects. The position is one for life and carries with it a good salary. It is understood that Mr. Ryan will not have to drop all his technical reporting, a matter of congratulation to the societies he has served so long and so ably.

MR. DUNBAR WRIGHT, vice-president of the Automobile Club of America, gave an illustrated lecture at the club on April 30 on Japan, Honolulu, Mexico, the Yosemite Valley, and other picturesque localities of the United States. The feature of the talk was the large number of beautifully colored pictures illustrating the scenes described by Mr. Wright, which he took and colored himself. The Japanese views were particularly delicate in tone, but among the pictures which attracted marked attention were a series of about twenty illustrating a bullfight in the City of Mexico taken by Mr. Wright during the past year. He showed them last night for the first time. It was the first illustrated lecture on a subject other than of technical automobile interest given in the new rooms, and the attendance was the largest that has turned out since the Tuesday night talks were inaugurated.

HUTCHINSON—DIMOCK.—The wedding of Dr. Cary Talcott Hutchinson, the well known electrical engineer, and Miss Susan M. Dimock, daughter of Mr. and Mrs. Henry F. Dimock, and a niece of William C. Whitney, was celebrated at 25 East Sixtieth Street, the New York residence of the bride's parents, on April 30. The Rev. Arthur H. Judge, of St. Matthew's, was the officiating clergyman. The bride had no attendants, and her father gave her away. Her gown of cream-white satin had its bodice trimmed with old lace and embroidered in pearls. A flounce of the old lace sprinkled with orange blossoms went about the skirt of the gown and met the long train. The bridal veil was of the same old and sheer lace, and was fastened to her coiffure with orange blossoms. Her bouquet of white orchids and lilies of the valley was arranged in a shower. Mr. Hutchinson's best man was his brother, Christy Hutchinson, of St. Louis. There were no ushers. The house was decorated with many long-stemmed American Beauty roses. The wedding was a very small one, and outside of relatives but a few intimate friends were asked to it. The honeymoon will be spent at South Coventry, Conn.

Trade Notes.

REMOVAL.—The Calculagraph Company has moved its offices from 2 Maiden Lane, New York, to 9-13 the same street.

MR. D. S. HOLCOMB, 51 Dey Street, New York, has increased his facilities and floor space, and is now carrying a very large line of new and second-hand electrical machinery.

THE PENCOYD PLANT, of the American Bridge Company, shipped during March 7339 tons. We believe this is the largest shipment ever made by any bridge shop in the world.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY has moved its offices and salesrooms to Fisher Building, Chicago, and its factory from Chicago to Winthrop Harbor, Ill.

MAPS.—Geo. W. Lord, 2238 North Ninth Street, Philadelphia, is issuing pocket maps of the United States, Porto Rico and the Philippines. Any of our readers can get a set by applying for them.

THE GEERLINGS-BECKER COMPANY has been formed in Milwaukee, Wis., for the purpose of maintaining a first-class repair shop for electrical machinery and apparatus, and to manufacture commutator segments.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY, Providence, R. I., has contracted to supply the Stanley Electric Company with a 48-point automatic telephone system for its new plant at Pittsfield, Mass.

THE CENTURY ELECTRIC COMPANY is the name of a new firm of electrical engineers and contractors, located at 31 Second Street, San Francisco. L. D. Hitzcroth is the president and S. H. Weidenthal secretary of the company.

WESTINGHOUSE PLANT SUBMERGED.—The plant of the Westinghouse Electric & Manufacturing Company, at East Pittsburg, Pa., suffered damage by the recent floods in that section. The buildings were submerged for twenty-four hours.

LARGE EXHAUST HEADS.—Two of the largest exhaust heads in the country, one 30-inch and one 36-inch, were recently installed by the Edison Electric Illuminating Company, of Boston, Mass., in its new station. They are of the Sturtevant centrifugal type, built by the B. F. Sturtevant Company, of Boston, Mass.

FIREPROOF OFFICES.—The Crane Company, Chicago, manufacturer of valves, fittings, etc., has decided to erect a modern fireproof building exclusively for offices. It will be about 90 ft. x 100 ft., five stories and basement, and will be located in the vicinity of its large cast iron and malleabe fitting and valve works, at Canal and Twelfth Streets.

THE HARTFORD FAIENCE COMPANY, Hartford, Conn., is doing some fine work on delicate porcelain pieces for electrical uses. It has a plant of a large capacity and is at present keeping three 10 ft. 6 in. kilns busy on electrical porcelains. It is devoting its energies to the specialties difficult of production rather than to the simpler pieces, and the results shown appear to justify this course.

DRIVER-HARRIS WIRE COMPANY, of Newark, N. J., writes us: "We are making a new resistance wire which we call 'S. B.' alloy. It is made particularly for measuring instruments and other work requiring great accuracy. Its properties are as follows: Resistance, 33 times copper; temperature, coefficient .00002. The thermo-electric effect against copper is almost as low as that of manganin.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is compiling a new fan motor catalogue for this season, in which it has listed Falcon, Diehl, General Electric, Tuerk, Westinghouse, Central, Empire and Battery fan motors. A copy of this catalogue will be sent to any one upon application. This company has also a new complimentary order book which it will send, postpaid, to any customer who so desires."

ITALIAN ELECTRICAL INSTRUMENTS.—Camillo Olivetti, of Ivrea, Italy, in a recently issued catalogue describes and illustrates in detail a line of electrical measuring instruments of his manufacture, which are listed under the heads of scientific and industrial instruments. The former include galvanometers of the Thomson and D'Arsonval type, and the latter consist of a line of hot-wire and Weston type ammeters and voltmeters.

THE UNION HARDWARE & ELECTRICAL SUPPLY COMPANY, which was burned out of its store on Weybosset Street, Providence, R. I., on March 27, has established itself temporarily around the corner on Eddy Street, where, after disposing of its damaged stock at special sale, it has put in a large new stock. It started its traveling men out again on April 22. The burned-out building is being refitted for it and it hopes to be back in its former quarters about June 1.

HYDRAULIC BENDERS.—The Watson-Stillman Company, 204 East Forty-third Street, New York, has issued a catalogue of its hydraulic benders. These machines are used for bending heavy metal forms, rails, electric conductors, etc. The catalogue is fully illustrated, and includes a telegraph code and an index of illustrated sheets issued by the company. The Watson Company's printing matter includes over 500 illustrated sheets, covering machinery for a great variety of purposes.

THE SIMPLEX STEEL CONDUIT COMPANY, Limited, Birmingham, England, will be glad to forward a copy of its catalogue, which has recently been issued, on receipt of inquiry. All interested in the question of conduit wiring are invited to write for a copy of this book, which is full of valuable information respecting the subject with which it deals. The company's English addresses are Coventry Street, Birmingham; Mansion House Chambers, London, and 1 Peel Street, Manchester.

THE HAINES & NOYES COMPANY, Chicago, is manufacturing new styles of telephones, and it is making some valuable improvements to its apparatus, all of which is described in its new bulletins. It informs us that it is now prepared to bid on installations of any size, and that its new factory is fully equipped with machinery which will enable it to make up any special apparatus. It makes a specialty of private telephone plants and of manufacturing special apparatus for the trade.

THE EXETER MACHINE WORKS, of Pittston, Pa., who are engaged in manufacturing a high grade line of hoisting engines, mining, elevating and conveying machinery are laying special emphasis on the coal handling machinery as applied to the unloading of coal at the dock and conveying to its proper destination; and also to the coal and ashes conveying machinery as applied to electric light stations and street railway plants. Their apparatus, which is being installed in lighting and power plants, is illustrated in pamphlet and catalogue, which can be obtained on application.

EXHAUST FANS.—The Emerson Electric Manufacturing Company in Bulletin No. 3029 briefly outlines its alternating and direct-current exhaust fans, direct connected. An illustration shows an 18-inch direct-connected, alternating-current exhaust fan. The Emerson Company has also issued a reprint of a letter addressed to the Committee of the City Council of Fostoria, Ohio, from Mr. W. D. Marks, president of the City Light, Heat & Power Company, of that city. The subject of the letter is, "Rates for Electric Service," and the figures given will be very valuable to every one interested in this subject.

THE GENERAL ELECTRIC COMPANY, LIMITED, 67 to 92 Queen Victoria Street, London, in a recent catalogue gives a long list of fire alarms, electric clocks, telephones and accessories, electric locks, water level indicators, etc. The catalogue is very complete and contains many illustrations of the apparatus referred to. In another catalogue issued by the same company is listed electric light supplies, switches, switchboards, cut-outs, lamp holders, incandescent lamps, etc. This also is very completely illustrated, showing the various styles of machines and apparatus of these various classes manufactured by this company.

TELEPHONE CABLES.—The Central Electric Company, of Chicago, is distributing a folder on National Telephone Cables, which contains many points of interest to users of this material. The paper used in insulation is said to be purer, heavier and 1/8-inch wider than that used in other cables. This makes the cable larger in diameter, thereby making it necessary to use more lead in the casing. The result of this is the cable is not so apt to break when bent. It is also the cause of the cable weighing more per foot than other cables. A single thickness of paper used in these National cables offers a resistance of 500 megohms per mile.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, of London, England, has recently issued a handsome catalogue of its electric traction department, including both power plant and rolling stock. The pamphlet is well illustrated by views of the well known Brush apparatus. A number of the pages are devoted to the electric traction trucks made by this company, and considerable space is given to the open and closed cars which it manufactures. The descriptions are rather short, but are arranged in an attractive manner and bring out the good points of the apparatus without surfeiting the reader with a large amount of self-praise.

SEARCH LIGHTS.—The United States Government has recently ordered a number of search light projectors for naval vessels from the Carlisle & Finch Company, of Cincinnati, which has established a wide reputation as manufacturer of search lights. It is making a line of search lights for all classes of seagoing and river steamers, and while not so expensive nor complicated as the navy standard projectors, are nevertheless fitted with the same carbon feeding mechanism and the same high grade mirrors. The commercial type projectors are finished in dead black brass, polished brass or white enameled iron, according to the wishes of the purchaser. A beautifully finished 9-inch diameter projector is made for yachts and launches.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, reports a steady increase of business in all departments. A few months ago 10,000 square feet of additional floor space were added to its already large and well equipped factory, and arrangements have been recently made for the addition of 21,000 more. This will be equipped with the most modern machinery, and will facilitate the handling of orders with even greater promptness than heretofore. The small switchboards of the "Express" type which this company recently put on the market have proven very popular and are in great demand, orders for over fifty having been received since March 15. In order to meet the demand for silk and cotton-covered wire and switchboard cable, the insulating department has been increased to double its former capacity, and is prepared to fill orders for any size or kind of silk or cotton-covered wire on short notice. The company also announces that it owns 90,000 of the finest cedar poles in Michigan, which it is prepared to supply in carload lots at lowest prices.

FRINK REFLECTORS.—The merits of the Frink special patent window reflector are so well known, that its success would seem to be a foregone conclusion. We note with interest that this enterprising and progressive house is not only lighting the finest department stores in this country, but is reaching out after foreign trade as well. Among the latest installations in the show window line are that well known firm, the J. E. Manix Dry Goods Company of Nashville, Tenn., and the show windows of the large department store of Señor Tomas Mendirichaga, Monterey, Mexico, who also uses a large number of cluster reflectors for lighting the store interior, with the most happy results. A large order has also been received for the show windows of one of the best known houses in Dublin, Ireland. For the thorough diffusion of an even light over the entire window space without glare in the eyes of the observer, there is nothing equal to it; it makes the ideal light for show windows. We might also call attention to the line of cluster reflectors manufactured by this firm for the lighting of store interiors, etc., which give a splendid light, make an exceedingly nice appearance, and are very durable. The firm, I. P. Frink, 551 Pearl Street, New York, will cheerfully furnish any information desired on request.

THE DE DION-BOUTON "MOTORETTE" COMPANY, Brooklyn, N. Y., is making final preparations for placing on the American market a De Dion motor of eight horse-power. This motor is a genuine De Dion, and it will be offered to the American trade exclusively. The success of the five horse-power motor that has now been on the market for some time, assures the success of the eight horse-power machine. The tendency both in France, England and America is for vehicles of higher power. This motor has a cylinder bore of 100 millimetres and a stroke of 110 mm. It weighs 110 pounds complete, without the extra flywheel, and 140 pounds including this flywheel and the friction clutch, the clutch being a part of the flywheel. This eight horse-power new De Dion motor forms the power equipment of the "Paris" type motorette, which is now under construction at the Brooklyn works. The "Paris" type motorette will be ready for the market on or about May 15. It embodies all of the very latest French ideas in automobile construction. Another new motorette is the improved "Brooklyn" type, which really is a modification of the "Paris" model. The "Brooklyn" will have the motor in front, the power being either a 3-hp De Dion motor or one of 3½-hp. This vehicle is reasonable in price, and already indications are that it will have a very large sale. The Motorette Company now has a full line from small tricycles up to the new 8-hp.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that the success with which it has met in introducing its new G. I. flush push button switches is extremely gratifying. This switch is designed to obviate many of the difficulties encountered in other switches. The mechanism is of a peculiar construction which insures absolute certainty of a quick make and break of the contact parts. After the button has been pushed to a certain distance, the making and breaking of the contact is absolutely beyond the control of the operator's hand. This special construction of the moving parts is a further advantage in avoiding the possibility of the switch being left on any dead centre. The company states that the business in its lighting supply department has never been better. Its salesmen report that business is opening up from all over the country in a most satisfactory manner. It has also got out an electric time switch by the use of which the lights, in connection with the clock, can be set to turn off and on at any time required. When once set it operates continuously, needing no attention except winding every eight days. The switch is especially adapted for show windows, store rooms, advertising signs, etc. It is claimed that by the use of this switch the cost of lighting will be reduced at least 75 per cent. Every merchant using electricity will certainly be interested when he is shown this feature, as the switch readily pays for itself in two or three months. The switch is operated by a handsome eight-day clock with double spring lever and large eight-inch dial, mounted with an attractive nickle-plated case. Catalogues and descriptive matter will be mailed upon application.

MR. WILLIAM ROCHE, 42 Vesey Street, New York, manufacturer of the New Standard dry battery, has just received from the Naval Torpedo Station at Newport, R. I., an excellent and gratifying letter showing the results of a test made of his batteries at that station by Lieut. Commander Hodgson, U. S. N. The letter, which is signed by N. E. Mason, Commander, U. S. N. Inspector of Ordnance, in charge, says in part: 1. "Referring to tests made of the Roche Standard dry cell. 2. The tests made show that the manufacturer sustains the reputation he has acquired for producing a most excellent and satisfactory dry cell. In recuperative power it shows a marked advance over previous cells. It was placed on a dead short circuit for 30 hours and when taken off was dead, reading only 0.1 on voltmeter. After remaining on open circuit for 9 days it was tested and showed 1.2 volts with an internal resistance of 1.1 ohms, quite enough current to fire a primer. On this date, 8 days later, though the internal resistance has increased to 1.6, the cell is still able to do the work that would be required of it in a firing battery." Business has increased to such an extent with Mr. Roche that he has three times increased his factory to take care of his rapidly extending business. In addition to his regular line of dry batteries of various sizes, his gas engine generator set for automobiles and other purposes to which a gas engine is put, is meeting with exceptional success. Many new features having been added since it was first brought out, patents for which were issued to Mr. Roche on April 16, 1901. This is a new departure in ignition plugs. In plugs heretofore used bridging was of common occurrence. This will be eliminated in the new plug. Sparking externally is prevented by a tail of the insulating material or plug proper of which the insulator is composed.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 23, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

672,236. ELECTRICAL RESISTANCE WITH SMALL HEATING CAPACITY; Karl Ochs, of Berlin, Germany. App. filed Sept. 16, 1899. A coil of wire adapted to being approached to a white heat is thinly coated with a heat-conducting insulating body which expands and contracts under the heat generated, at the same rate as the conductor. (Issued April 16.)

672,445. ACTUATING MECHANISM FOR AUTOMATIC RAILWAY APPLIANCES; S. W. Huff, Baltimore, Md. App. filed Jan. 17, 1898. This device, which is to be attached to the track in a manner to be operated by the wheels of a train for the purpose of transferring the motion to a signal or other apparatus, is constructed so that the first impact of the wheels will not be transmittted to the signal, thus avoiding the shock which would otherwise be imparted to the signal apparatus.

672,449. ELECTRICAL CONDUCTOR; W. A. Markey, Saginaw, Mich. App. filed Aug. 31, 1900. The conductor is a porous body having particles of silver distributed uniformly throughout its pores.

672,451. ELECTRIC LIGHT VACUUM TUBE; D. M. Moore, Newark, N. J. App. filed March 26, 1898. The tube is devoid of interior electrodes, but its extremities are roughened and electroplated with a conducting material.

672,452. ELECTRIC LIGHT APPARATUS; D. M. Moore, Newark, N. J. App. filed April 15, 1898. This improvement relating to vacuum tube lighting consists of a circuit interrupter having a number of points of interruption controlling separate branches of a circuit of induction, and an induction coil, the primary of which receives the discharges of said circuit.

672,459. MEANS FOR SUPPLYING POWER FROM STATIONARY RAILS TO VEHICLES MOVING ON THE RAILS; R. C. Sayer, Bristol, Eng. App. filed Aug. 3, 1899. The rail is tubular and provided at short intervals with valved openings, the rim of the wheel carries plungers which open the valves and at the same time rotate the valve stem in a manner to make contact with the conductor in the tube and close the circuit to the motor.

672,489. SUPPORTING DEVICE FOR ELECTRIC LAMPS; E. J. McAllister, A. D. Page and L. C. Werner, Newark, N. J. App. filed Jan. 11, 1901. Electric sign lamps are connected together by clips in the form of the figure eight, which embrace the sockets of the lamp and permit them to be shifted in position with respect to one another.

672,513. ELECTRIC SWITCH; J. Reid, Jr., Watervliet, N. Y. App. filed Jan. 28, 1899. Details.

672,524. AMALGAMATOR; G. Ghiglieri and J. M. Schofield, Stockton, Cal. App. filed Aug. 4, 1899. Details.

672,546. TELEPHONE METERING SYSTEM; D. M. Bliss, Lowell, Mass. App. filed Nov. 27, 1899. A method consisting in impressing upon the line a slow pulsating current while the telephone is in use to operate a recording instrument, the current being incapable of affecting the telephone instrument.

672,563. ACCUMULATOR BATTERY; P. Marino, Brussels, Belgium. App. filed April 10, 1900. Details.

672,588. ELECTRICAL SWITCH; W. F. Bossert, Utica, N. Y. App. filed Dec. 4, 1900. The clip to receive the blade is made of a metal strip doubled upon itself, the loop forming a foot piece of double thickness through which the fastening screw passes.

672,589. INTERIOR CONDUIT CAPPING; W. F. Bossert, Utica, N. Y. App. filed Feb. 13, 1901. The capping furnishes a rounded bead at the outlet of the tube.

672,597. ELECTRIC ARC LAMP; A. De Puydt, Liege, Belgium. App. filed Dec. 4, 1900. The magnet oscillates and moves an actuator for the carbon holder.

672,601. TAPPING DEVICE FOR ELECTRIC FURNACES; O. Frolich, Steglitz, Germany. App. filed May 15, 1899. (See Current News and Notes.)

672,603. SYSTEM OF ELECTRIC DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed March 13, 1901. Counter-acting coils are provided to control the field of a dynamo by which a motor moving an end-cell switch is actuated so that when the equilibrium is disturbed the end cells of the battery are cut in or out until the equilibrium is restored.

672,604. COMMUTATOR BRUSH AND BRUSH HOLDER; R. Lundell, New York, N. Y. App. filed Oct. 10, 1900. Two or more commutator brushes of different resistance are secured in independent portions of a brush holder, and in such relation to each other that a high resistance brush is located at the leaving edge of the low resistance brush.

672,607. GLOWER SUPPORTING PLUG FOR ELECTRIC LAMPS; J. Van Vleck and W. N. Stevens, New York, N. Y. App filed April 27, 1900. The glower supporting plug is of non-conducting material having the external form of an Edison lamp base. One end of the plug has a conical surface and the glower is supported in close proximity to this surface.

672,608. INSULATED RAILROAD RAIL JOINT; G. A. Weber, Stamford, Conn. App. filed Dec. 7, 1900. Structural details of a rail joint and chair.

672,621. TELEPHONE TRANSMITTER; C. C. Hughes, Baltimore, Md. App. filed April 14, 1900. Details.

672,626. RAILWAY SIGNAL; J. D. Price, Aurora, Ill. App. filed April 11, 1900. An arrangement of circuits in a block systhem whereby the signals are displayed in the engine cab.

672,629. TELAUTOGRAPH; G. S. Tiffany, Highland Park, Ill. App. filed Aug. 26, 1898. In order to send over the line impulses of opposite polarity which are less affected by the static capacity of the conductor than impulses of light polarity, it is proposed to transmute the movements of the transmitting pen into high tension induced impulses at the transmitting station.

672,630. TELAUTOGRAPH; G. S. Tiffany, New York, N. Y. App. filed Nov. 22, 1900. The pen point rests upon and is sealed by, a cushion when at rest, to avoid drying up of the ink.

672,631. TELAUTOGRAPH; G. S. Tiffany, New York, N. Y. App. filed Nov. 22, 1900. When the sender has finished sending a message, an alarm is automatically sounded until the main switch is moved to cut out the transmitter.

672,639. CONDUCTOR AND CONTACT FOR ELECTRICAL GLOW LAMPS; J. A. Halford, Bayswater, Eng. App. filed Jan. 21, 1901. The lamp carries a pair of spikes adapted to penetrate the conductors and the socket is provided with means for attaching the lamp to the molding at the same time the electrical connection is made.

672,640. AUTOMATIC BOOSTER IN CONNECTION WITH MULTIPLE WIRE SYSTEMS; J. S. Highfield, St. Helens, Eng. App. filed Feb. 2, 1901. Applies to a three-wire circuit supplied from a storage battery. A booster is interposed between each terminal of the battery and the corresponding bus-bar; the booster has a double-coil field magnet, of which one coil is a fine wire and connects the pole of the battery to which the booster is connected to the armature of an exciter driven at constant speed by an electric or other motor, which also drives the booster.

672,642. ELECTRIC INCANDESCENT LAMP; L. J. P. Hollub and H. Mignal, Paris, France. App. filed Nov. 8, 1900. Details.

672,653. TROLLEY FOR ELECTRIC RAILWAY CARS; A. Schneider, Lexington, Ky. App. filed Oct. 16, 1900. V-shaped arms to aid in guiding the wheel onto the wire.

672,662. DESK TELEPHONE; A. K. Andriano, San Francisco, Cal. App. filed Sept. 25, 1899. A desk set having a sliding switch in the base for co-operation with an automatic exchange.

672,712. SYSTEM OF ELECTRODYNAMIC PROPULSION; L. Rosenfeld, C. Zelenay and J. Dulait, of Charleroi, Belgium. App. filed Jan. 31, 1900. The induction element of a polyphase motor is suspended on the vehicle and the inductor element extends along the track.

672,715. GALVANIC BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed Oct. 30, 1900. A device for application to the cell adapted to support both elements.

672,727. MEANS FOR PROTECTING COMMUTATORS; A. D. V. Baldwin, New York, N. Y. App. filed Feb. 14, 1901. A cylindrical casing of insulating material surrounding the commutator and having openings for the brushes.

672,877.—Electric Lighting System for Railway Cars.

672,741. ELECTRIC RAILWAY TROLLEY; C. H. Myers, Buffalo, N. Y. App. filed Nov. 30, 1897. Details of construction of a trolley arm over which the main and return conductors pass, the arm carrying two separated wheels making contact with the main and return conductors respectively.

672,770. ELECTRIC ARC LAMP; C. Holmok and J. Holmok, Cleveland, Ohio. App. filed Jan. 21, 1901. The magnet is constructed with the smallest possible air gap, to permit of the use of less magnet wire in order to obtain the required density of magnetic lines.

672,830. RAILWAY SIGNAL SYSTEM; W. W. Hoffman and F. W. Powers, West Lafayette, Ind. App. filed June 6, 1900. The trains carry a trolley which runs in contact with a signalling wire running to the various stations along the road.

672,831. TROLLEY; W. W. Hoffman and F. W. Powers, West Lafayette, Ind. App. filed Oct. 1, 1900. The trolley is attached to the side of the car in such a manner as to be in control of a person on the inside of the car.

672,841. ELECTRIC MALLET OR HAMMER; C. D. Olsen, Denver, Colo. App. filed Jan. 18, 1900. Details.

672,851. ELECTRIC TRANSMISSION OF MOTION FOR STEERING SHIPS OR FOR OTHER PURPOSES; H. A. Spiller, Boston, Mass. App. filed Oct. 30, 1891. In connection with a shaft driven by an electric motor, is a circuit interrupting switch, and means are provided for determining the extent of movement of the shaft from any one of a number of selected localities.

672,877. ELECTRIC LIGHTING SYSTEM FOR RAILWAY CARS; J. W. Guillott, Chicago, Ill. App. filed May 15, 1896. The dynamo feeding lights or other devices on a train is driven by a windmill exposed to the rush of air caused by the moving train.

672,878. ELECTRIC LIGHTING SYSTEM FOR RAILWAY TRAINS; J. W. Guillott, Chicago, Ill. App. filed July 20, 1896. The generator is regulated by a fan exposed to the speed of the train.

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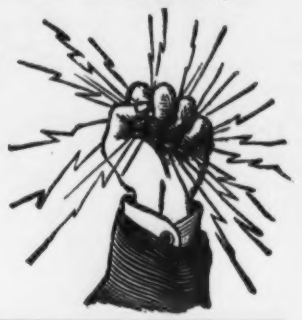

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CONTINUED ON PAGE 72.

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